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U.S. Army
Environmental
Center

FORT DEVENS FEASIBILITY STUDY FOR GROUP 1A SITES

FINAL FEASIBILITY STUDY REPORT

COLD SPRING BROOK LANDFILL OPERABLE UNIT
DATA ITEM A009

CONTRACT DAAA15-D-008
DELIVERY ORDER NUMBER 0004

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U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

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Prepared for:

U.S. Army Environmental Center
Aberdeen Proving Ground, Maryland

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine
Project No. 07005-08

DECEMBER 1994

FORT DEVENS FEASIBILITY STUDY (FS) FOR GROUP 1A SITES
COLD SPRING BROOK LANDFILL OPERABLE UNIT

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EXECUTIVE SUMMARY

The U.S. Army Environmental Center directed ABB Environmental Services, Inc. (ABB-ES), under Contract No. DAAA15-91-D-0008, to conduct a Feasibility Study (FS) to evaluate alternatives to reduce potential human health and ecological risks at the Cold Spring Brook Landfill Operable Unit at Fort Devens, Massachusetts. The Cold Spring Brook Landfill Operable Unit consists of the Cold Spring Brook Landfill and adjacent Cold Spring Brook Pond. The Cold Spring Brook Landfill is identified as Solid Waste Management Unit 40 in the Fort Devens Master Environmental Plan and as Area of Contamination 40 in the Federal Facility Agreement (Interagency Agreement) between the U.S. Department of the Army and the U.S. Environmental Protection Agency (USEPA).

Cold Spring Brook Landfill extends approximately 800 feet along Patton Road and out into the former wetland along Cold Spring Brook, now mostly submerged beneath Cold Spring Brook Pond. Review of aerial photographs shows that Patton Road formerly curved around the wetland before realignment in the mid-to-late 1960s (Detrick, 1991; Figures 21, 22, and 23). The aerial photographs indicate that deposition of material at the landfill coincided with the realignment of Patton Road. The landfill was apparently a disposal area for demolition debris. Identified wastes at the landfill include concrete slabs, wire, storage tanks, rebar, timber, and debris (U.S. Army Environmental Hygiene Agency [USAEHA], 1988) (Figure ES-1). In addition, 14 discarded 55-gallon drums were discovered at the landfill in 1987 (USAEHA, 1988).

The Remedial Investigation (RI) Addendum Report evaluated potential human health and ecological risks associated with exposure to site contaminants in surface soil, groundwater, pond surface water, pond sediments, and fish (ABB-ES, 1993b). Human health risks exceeded the USEPA points of departure (i.e., risk management guidelines corresponding to cancer risks exceeding $1x10^{-6}$ and noncancer hazard index values exceeding 1) only for the risk scenario of residential exposure to groundwater under future land-use conditions - there is no residential groundwater exposure under current land-use conditions. The two groundwater contaminants exceeding USEPA human health points of departure were arsenic and bis(2-ethylhexyl)phthalate.

The ecological risk assessment identified potential low levels of risk to aquatic receptors at two hot spot areas of sediment contamination. Arsenic and lead are sediment contaminants that were the primary contributors to ecological risk.

Based on the results of the risk assessments, the following remedial action objectives were developed for the Cold Spring Brook Landfill Operable Unit:

GROUNDWATER	
•	Prevent future residential exposure to groundwater exceeding the following concentrations: aluminum (6,870 µg/L[1]), arsenic (50 µg/L), iron (9,100 µg/L), manganese (291 µg/L), sodium (20,000 µg/L), and bis(2-ethylhexyl)phthalate (6 µg/L).
SEDIMENT	
•	Prevent ecological exposure to hot spot concentrations of arsenic and lead at Sediment Areas I and II.
•	Minimize alteration and potential impacts to Cold Spring Brook Pond and associated wetland.
•	Meet location-specific and action-specific Applicable or Relevant and Appropriate Requirements.

1 µg/L = micrograms per liter

Four candidate remedial alternatives were developed and evaluated according to the two threshold and five balancing criteria recommended in USEPA RI/FS guidance for their ability to meet the remedial action objectives. The following matrix presents the major components of the four candidate alternatives.

REMEDIAL ACTION	CSBL-1	CSBL-2	CSBL-3	CSBL-4
	ALTERNATIVE			
Groundwater Monitoring	X	X	X	X
Sediment and Biological Monitoring		X	X	X
Zoning and Deed Restrictions		X	X	
Drum Removal and Disposal		X	X	X
Hot Spot Sediment Removal		X	X	X
Wetland Restoration		X	X	X
Landfill Surface and Bank Improvements		X		
Landfill Capping			X	
Landfill Excavation				X

Alternative CSBL-1, the No Action alternative, takes no action to reduce potential human health and ecological risks associated with exposure to site media and contaminants. However, available groundwater monitoring data indicate that groundwater at wells used in the risk assessment of the RI Addendum Report does not exceed the Maximum Contaminant Level (MCL) of 50 μg/L for arsenic, and that average groundwater quality does not exceed the MCL of 6 μg/L for bis(2-ethylhexyl)phthalate. Groundwater quality may exceed Preliminary Remediation Goals based on background concentrations and regulatory guidance for aluminum, iron, manganese, and sodium.

Alternative CSBL-2, Drum Removal/Hot Spot Sediment Removal, provides protection of human health through implementation of institutional controls (zoning and deed restrictions on residential development and placement of residential wells) and long-term environmental monitoring. Because there is no current residential groundwater exposure and because the landfill and surrounding land are owned completely by the U.S. Army, there is unique potential for Alternative CSBL-2 to be

protective of human health. Hot spot sediment dredging will reduce ecological risk from exposure to contaminated sediments. Drum removal will remove a potential source of contamination, and landfill surface and bank improvements will remove physical hazards associated with protruding debris and surface depressions at the landfill.

Alternative CSBL-3, Landfill Capping/Drum and Hot Spot Sediment Removal, is based on Alternative CSBL-2, but with installation of a low-permeability cover system instead of surface and bank improvements. The low-permeability cover will reduce infiltration to and potential leaching of landfill debris. However, the current contribution of leaching to groundwater and sediment contamination is not quantified, and the benefits of a low-permeability cover in comparison to surface and bank improvements are not clear.

Alternative CSBL-4, Landfill Excavation/Drum and Hot Spot Sediment Removal, is similar to Alternative CSBL-3, but with excavation and consolidation of landfill debris at a consolidation facility instead of landfill capping. Excavation of landfill debris will remove the landfill as a potential source of groundwater and sediment contamination. However, because current contributions are not quantified, the benefits of landfill excavation in comparison to the surface and bank improvements of Alternative CSBL-2, and the landfill capping of Alternative CSBL-3 are not clear. Implementation of Alternative CSBL-4 requires identification of a consolidation facility capable of accepting an estimated 100,000 cubic yards of excavated debris from the Cold Spring Brook Landfill.

Increasing amounts of wetland alteration and habitat disturbance are associated with Alternatives CSBL-2, CSBL-3, and CSBL-4, and increased amounts of wetland restoration would be required for each.

The estimated present worth of Alternative CSBL-1 at $385,000 is the lowest of the four alternatives. The estimated present worth of Alternative CSBL-2 is $1,980,000 and of Alternative CSBL-3 is $3,468,000. Alternative CSBL-4 has an estimated present worth of $6,788,000, approximately two times the next lower cost alternative.

1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), prepared this Feasibility Study (FS) Report as part of the FS effort for Group 1A Sites at Fort Devens, Massachusetts. This work was conducted in accordance with the U.S. Army Environmental Center (formerly U.S. Army Toxic and Hazardous Materials Agency) Contract DAAA15-91-D-0008, Delivery Order 0004. The Group 1A Sites were identified for investigation in the Fort Devens Master Environmental Plan, and are subject to a Federal Facility Agreement (FFA) (Interagency Agreement [IAG]) between the U.S. Department of the Army and the U.S. Environmental Protection Agency (USEPA, 1991a). Fort Devens was placed on the National Priorities List (NPL), effective December 21, 1989. This FS was prepared in accordance with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988b).

The Group 1A Sites consist of the sanitary landfill incinerator, Area of Contamination (AOC) 4; sanitary landfill No. 1 or Shepley's Hill Landfill, AOC 5; the asbestos cell, AOC 18; and Cold Spring Brook Landfill, AOC 40. Figure 1-1 shows a Site Location Map for the Group 1A Sites.

Fort Devens was identified for closure by the Base Realignment and Closure Act of 1991, and will cease to be an active Army installation on September 30, 1995. Although a small military presence will remain, a major portion of the post will be released for development.

1.1 PURPOSE AND ORGANIZATION OF REPORT

The purpose of this FS Report is to:

- establish response objectives to reduce actual or potential risks to human health or the environment at the Cold Spring Brook Landfill Operable Unit;
- identify the types of response actions necessary to achieve response objectives;

- identify and screen specific remedial technologies that may be capable of attaining response objectives;
- develop and evaluate a range of remedial alternatives based on those technologies; and
- compare the alternatives with each other in accordance with criteria recommended by USEPA.

This FS Report is based on information and data presented in the Remedial Investigation (RI) Report prepared by Ecology and Environment, Inc. (E&E, 1993) and the RI Addendum Report prepared by ABB-ES (ABB-ES, 1993b). This report also presents updated information from the Regulatory Draft Preliminary Remedial Technology Screening document (ABB-ES, 1992) and the Draft Alternatives Screening Report (ABB-ES, 1993a). Figure 1-2 is a schematic of the FS process.

This FS Report consists of six sections. Section 1.0 provides a brief description and history of the Cold Spring Brook Landfill. It also summarizes the nature and extent of contamination and the baseline risk assessment presented in the RI Addendum Report (ABB-ES, 1993b).

Section 2.0 discusses chemical-specific, location-specific, and action-specific Applicable or Relevant and Appropriate Requirements (ARARs) and their role in site remediation. Section 3.0 identifies remedial action objectives and identifies and screens potential remedial technologies.

Section 4.0 develops and screens potential remedial alternatives for the Cold Spring Brook Landfill Operable Unit. Section 5.0 contains the detailed analysis of alternatives and Section 6.0 contains the comparative analysis of alternatives.

1.2 Site Description and History

Cold Spring Brook Landfill occupies approximately 4 acres along the edge of Patton Road in the southeastern part of the Main Post. It extends for approximately 800 feet along Patton Road and out into the former wetland along Cold Spring Brook, now mostly submerged beneath Cold Spring Brook Pond

(Figure 1-3). The upper surface of the landfill slopes gently toward the north and east and varies in elevation from about 250 to 260 feet above sea level (ASL). It is densely covered with small trees and scrub, the trees being predominantly pines. The edge of the landfill falls off abruptly to the wetland or to the pond with an elevation drop that ranges between 10 and 20 feet. Based on visual observations at the edge of the landfill, the bottom of debris is estimated to extend to approximately 237 feet ASL.

Aerial photographs show that Patton Road formerly curved around the Cold Spring Brook wetland before realignment during the mid-to-late 1960s (Detrick, 1991; Figures 21, 22, and 23). Deposition of material at the landfill coincided with the realignment of Patton Road and apparently began very close to the edge of Patton Road. Based on terrain conductivity and magnetic survey data collected during the RI (E&E, 1993), Patton Road is interpreted to have been built on clean borrow material, and the landfill is interpreted to extend north from the road embankment. The elevation of the landfill along its southern edge is essentially the same as that of Patton Road. There is no roadside drainage ditch, and the existing surface of the landfill slopes down to the north toward the pond and toward the east at a rate of approximately 2 percent. Remnants of the old roadbed are still visible between well CSB-3 and Patton Road (see Figure 1-3). South of the old roadbed is a flat area with little vegetation that appears to have been excavated for gravel and sand. Beyond the apparent excavation area, a low hill covered with trees rises abruptly to about 350 feet ASL. Previous studies have not identified any landfilling in this area.

Cold Spring Brook Landfill is considered abandoned, and was identified in November 1987 when 14 55-gallon drums were discovered along the edge of Cold Spring Brook Pond. An identification number on the drums indicated that the original contents of several had been antifreeze manufactured by Union Carbide and that the drums were 15 to 20 years old. Apparently, the drums had been painted yellow and reused (U.S. Army Environmental Hygiene Agency [USAEHA], 1988). A response team from a Union Carbide facility in New Hampshire examined the drums in March 1988, identified seven Union Carbide drums, and sampled their contents. Analysis revealed the presence of chlorinated solvents and some metals (USAEHA, 1988). Other wastes at the landfill include concrete slabs, wire, storage tanks, rebar, timber, and debris (USAEHA, 1988). No landfill hot spots or suspect hazardous waste disposal areas were identified during RI or Supplemental RI activities.

The 3.5-acre pond was created between 1965 and 1972 by the raised inlet of the Patton Road culvert, as shown in aerial photographs from that period. The pond has a surface elevation of approximately 240 feet ASL, and depth that ranges from one foot or less at its western end to a maximum of approximately 6 feet near its eastern end.

Patton Well, a water supply well for Fort Devens, is located south of Patton Road, about 600 feet west of the landfill. Patton Well is screened from 46 to 76 feet below ground surface (bgs) and appears to tap the same aquifer as that monitored by several landfill wells. Patton Well operates on an on-demand basis at approximately 800 gallons per minute (gpm). A magazine area lies west of the pond, and Cold Spring Brook originates as drainage from a wetland in the center of this area. The brook drains north to Grove Pond, passing through several palustrine forested or scrub/shrub wetlands before reaching the pond.

USAEHA completed a hydrological investigation of Cold Spring Brook Landfill in 1988. Locations of the eight wells (i.e., CSB-1 through CSB-8) installed by USAEHA are shown in Figure 1-3. The investigation showed that the landfill is located over glacial sand and gravel deposits in, or adjacent to, a former wetland. U.S. Geological Survey (USGS) information indicates the area is underlain by swampy deposits of muck and peat, with adjacent units of sand and gravel from kame deposits.

Eight wetland vegetative cover types were identified in the vicinity of Cold Spring Brook Landfill. The wetland cover types and the areas they occupy are identified in Figure 1-4. These areas were identified during the RI by completion of New England Division Army Corps of Engineers Wetland Delineation Data Forms (E&E, 1993). Each wetland cover type meets the three criteria (i.e., hydrophytic vegetation, hydric soils, and wetland hydrology) necessary to be classified as jurisdictional wetland. There is no 100-year flood plain in the vicinity of Cold Spring Brook Landfill.

1.3 GEOLOGY AND HYDROGEOLOGY

1.3.1 Surficial Geology

Cold Spring Brook Landfill lies within the Ayer topographic quadrangle. The surficial geology of the Cold Spring Brook Landfill area is predominantly unconsolidated, silty sand to poorly graded medium to fine sand and organic palustrine sediments. The sands are associated with deposition in glacial Lake Nashua, which formed against the terminus of the Wisconsinan ice sheet. A topographically high kame plain, a prominent glacial depositional feature, is located south of Patton Road. Before construction of the landfill, a swampy area stretched from Cold Spring Brook to the base of the kame. The swamp, which may originally have been a kettle pond, extended from approximately 75 feet east of well CSB-2 to 50 feet east of well CSB-6. USGS maps from 1935 show Patton Road originally bending to the south around the swampy area near what is now well CSB-3. The remnants of this section of road are still visible. The present stretch of Patton Road in this area is built on fill.

Extensive peat deposits exist to the west of well CSB-5 between the northern margin of the landfill and Cold Spring Brook. At well CSM-93-01A, the remnants of this peat layer were first encountered at 19 feet bgs. Rubble and construction debris have deformed and mixed with the peat layer forming a matrix of well-graded sand and gravel within the peat. A second and presumably older peat layer was encountered at 34.5 feet bgs at well CSM-93-01A and extended to approximately 40 feet bgs, below which there are stratified sands.

1.3.2 Bedrock Geology

Bedrock was encountered at 129.6 feet bgs at well CSM-93-02B. Bedrock coring and classification were not performed at well CSM-93-02B or any of the other new or existing monitoring wells at Cold Spring Brook Landfill. However, bedrock in the area has been mapped as the Devens-Long Pond facies of Ayer Granite (Zen, 1983).

1.3.3 Cold Spring Brook Pond Sediment

Sediment cores obtained from the 10 vibratory core sampling locations showed a sediment blanket of highly organic, partially decomposed, viscous sediments (peat)

overlying fine to coarse sands and silty sands. The sediment thickness varies from 0.5 feet at CSD-92-10X to 4.7 feet at CSD-92-09X (see Figure 1-3). As would be expected, sediment layers were thickest in low energy, low flow environments and thinner in areas of higher water flow.

1.3.4 Groundwater Hydrology

The unconsolidated overburden represents the primary aquifer in the Cold Spring Brook Landfill area. Patton Well, located west-southwest of the Cold Spring Brook Landfill, is one of three groundwater production wells servicing the Main Post and is screened from 46 to 51 feet bgs and from 61 to 76 feet bgs. Groundwater flow in the area appears to mimic topography, flowing from the north and south and discharging into Cold Spring Brook Pond (Figure 1-3). Groundwater flow in the vicinity of CSB-2 and westward appears to be influenced by the pumping of the Patton Road Well.

Permeability testing of three newly installed Cold Spring Brook Landfill monitoring wells produced estimates of hydraulic conductivity for the overburden aquifer. Hydraulic conductivity estimates ranged from 1×10^{-3} centimeters per second (cm/sec) to 8×10^{-4} cm/sec. Additional details are provided in the RI Addendum Report (ABB-ES, 1993b).

1.3.5 Surface Water Hydrology

Cold Spring Brook Pond is the major surface water feature adjacent to the landfill. Cold Spring Brook Pond drains to Cold Spring Brook to the east via a culvert beneath Patton Road. The western corner of the pond is fed seasonally by surface water draining from the Magazine Area. Based on interpreted groundwater hydrology, the pond is also a groundwater discharge area. At times of low water levels, the western arm of Cold Spring Brook Pond, between CSB-1 and CSB-2, becomes isolated from the main pond as the connecting channel becomes discontinuous. In late summer and fall, standing water disappears from this area of the pond.

1.4 NATURE AND EXTENT OF CONTAMINATION

The RI and supplemental RI at the Group 1A sites assessed environmental contamination in the following media at Cold Spring Brook Landfill:

MEDIUM	INTERPRETED CONTAMINANT CLASSES
Source Area Soil	Semivolatile Organic Compounds (SVOCS), Pesticides, Inorganics
Source Area Groundwater	None
Cold Spring Brook Pond Sediments	SVOCs, Pesticides, Inorganics
Cold Spring Brook Pond Surface Water	Inorganics
Ambient Air	None

Sources: E&E, 1993; ABB-ES, 1993b

Soils. Three samples were collected from landfill cover materials during the RI in 1991 and analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) metals. Polynuclear aromatic hydrocarbons (PAHs) (up to 2.6 micrograms per gram [μg/g]) and the pesticide residues 2,2-bis(para-chlorophenyl)-1,1-dichloroethane (DDD) (up to 0.10 μg/g) and 2,2-bis(para-chlorophenyl)-1,1,1-trichloroethane (DDT) (up to 0.23 μg/g) were identified as cover soil contaminants. In addition, a number of inorganics were reported above background concentrations and are considered contaminants (E&E, 1993). Table 1-1 lists chemicals in cover soils exceeding soil background concentrations. Cover soil was not sampled during the supplemental RI in 1992.

Groundwater. Groundwater quality was characterized through two rounds of sampling at seven monitoring wells during the RI, and two confirming rounds at 10 wells during the supplemental RI. Target analyte groups for the two field programs are listed below.

	Field Program	
Analyte Groups	RI	Supplemental RI
Volatile Organic Compounds (VOCs)	X	
SVOCs	X	X
Pesticides and Polychlorinated Biphenyls (PCBs)	X	X
Explosives	X	X
Total Inorganics	X	X
Dissolved Inorganics		X
Anions	X	

Sources: E&E, 1993; ABB-ES, 1993b

The explosives 1,3,5-trinitrobenzene and 1,3-dinitrobenzene, detected in well CSB-1 at 7.94 micrograms per liter (μg/L) and 2.86 μg/L, respectively, were the only interpreted organic contaminants in groundwater in the RI Report. Inorganics were interpreted as contaminants in several wells, including upgradient/background wells (E&E, 1993).

Investigations during the supplemental RI allowed refinement of the hydrogeologic model for Cold Spring Brook Landfill and of the contamination assessment. Based on the hydrogeologic interpretation, wells CSB-3 and CSB-8 are upgradient of the landfill and CSB-1, CSB-6, and CSB-7 are cross-gradient of the landfill, while wells CSB-2, CSM-93-01A, are located downgradient but are screened below the water table. Wells CSM-92-02A and CSM-92-02B, screened at and below the water table, respectively, are interpreted to be slightly cross-gradient of groundwater flow at the western end of Cold Spring Brook Landfill. Although located close to the upgradient edge of the landfill, the boring log indicates that well CSB-8 is not constructed in landfill materials. Wells CSB-4

and CSB-5 are located in a peat formation considered unrepresentative of a productive aquifer and were not used during the contamination assessment.

The only Project Analyte List (PAL) organic detected in groundwater at Cold Spring Brook Landfill during supplemental RI sampling was bis(2-ethylhexyl)-phthalate. It was detected in the Round 1 sample from well CSM-93-02B at 14 $\mu g/L$. It was undetected (i.e., <4.5 $\mu g/L$) in the three primary Round 2 samples, but was reported at 4.4 $\mu g/L$ in the duplicate sample from well CSM-93-02B. The explosives 1,3,5-trinitrobenzene and 1,3-dinitrobenzene were not detected during Supplemental RI sampling.

Based on the distribution pattern for inorganics in unfiltered samples and comparison of data from filtered and unfiltered samples, the RI Addendum Report concluded that Cold Spring Brook Landfill is not a source of inorganic groundwater contamination. Table 1-2 summarizes average and maximum analyte concentrations in wells CSB-2, CSM-93-01A, CSM-93-02A, and CSM-93-02B.

Sediments. The characterization of Cold Spring Brook Pond was accomplished during both the RI and supplemental RI. RI sampling involved collection and analyses of shallow (0 to 6-inch depth) samples for TCL organics, explosives, TAL inorganics, and total organic carbon (TOC). The RI Report concluded that pond sediments were contaminated with the inorganics arsenic, lead, manganese, mercury, and zinc. Organic contaminants included PAHs (total concentration of 13 PAHs up to 79.6 $\mu g/g$), DDD (up to 1.29 $\mu g/g$), and 2,2-bis(para-chlorophenyl)-1,1-dichloroethene (DDE) (up to 0.202 $\mu g/g$) (E&E, 1993).

During the supplemental RI, sediment samples were collected at 16 locations and analyzed for PAL SVOCs, pesticides and PCBs, explosives, inorganics, and TOC. The RI Addendum Report concluded that pond sediments were contaminated with several PAHs, inorganics, and the pesticides DDD, DDE, and DDT. PAHs were detected most frequently and at the highest concentrations near the pond outlet. A second area of PAH contamination was also identified at the small cove near CSD-92-09X. Low concentrations of the pesticides DDD, DDE, and DDT were detected throughout the pond. The RI Addendum Report concluded that pond sediments are contaminated with arsenic, manganese, barium, iron, chromium, nickel, zinc, lead, and copper. Highest concentrations of arsenic and lead were also clustered at the small cove near CSD-92-09X. High concentrations of arsenic, barium, iron, lead, and zinc were also noted at sample location

CSD-93-01X near the pond outlet. Table 1-1 lists inorganic analytes exceeding Ontario Ministry of the Environment sediment guidelines (Persaud, 1992) at Cold Spring Brook Pond.

Surface Water. Nine surface water samples were collected from Cold Spring Brook Pond during the RI to characterize surface water quality. Target analytes included TCL organics, explosives, and TAL metals. The only organic reported in surface water was alpha-benzenehexachloride; however, it was interpreted to be a laboratory contaminant. Copper, iron, and zinc exceeded the ambient water quality criteria for the protection of aquatic life throughout the pond (see Table 1-1). Silver exceeded Ambient Water Quality Criteria (AWQC) in one sample (E&E, 1993).

Ambient Air. One ambient air sample was collected from a location on top of Cold Spring Brook Landfill during the RI and analyzed for VOCs and particulates. The low measured concentrations of toluene, xylene, and dichlorodifluoromethane were attributed to background conditions. No other VOCs were detected (E&E, 1993).

1.5 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

A Supplemental Risk Assessment was performed for Cold Spring Brook Landfill in the RI Addendum Report (ABB-ES, 1993b) to update the RI Risk Assessment completed in April 1993 (E&E, 1993). Figures 1-5 through 1-8 present risk estimates produced in the Supplemental Risk Assessment relative to USEPA risk management guidelines corresponding to cancer risks exceeding $1x10^{-6}$ and noncancer Hazard Index (HI) values exceeding 1. The risk estimates shown in Figures 1-7 and 1-8 for future residential groundwater use are updated from those contained in the Supplemental Risk Assessment (ABB-ES, 1993b). The spreadsheets included in Appendix M of the Final RI Addendum Report erroneously contained a factor for shower exposure time (ET). Figures 1-7 and 1-8 show risk estimates that do not include the factor ET.

Actual fish tissue analyses obtained through the October 1992 fish sampling program provided measured chemical of potential concern (COPC) levels in fish. The health risks faced by a recreational fisherman or family member who consumes fish from Cold Spring Brook Pond ranged from $1x10^{-6}$ to $9x10^{-6}$. These

risks fall within the USEPA target risk range. The maximum detected concentrations of mercury, DDE, and DDD in the fish at Cold Spring Brook Pond were also below their respective U.S. Food and Drug Administration (FDA) action levels. These are the only three COPCs for which the FDA has developed action levels.

As estimated in the RI Report (April 1993), the health risks associated with contact with surface soil at Cold Spring Brook Landfill fall below the USEPA point of departure of $1x10^{-6}$ excess cancer risk and target HI of 1. The cancer risks ranged from $2x10^{-7}$ to $6x10^{-7}$, and the HIs ranged from 0.000009 to 0.0001. Under current land use conditions, an adult and child were assumed to be exposed to soil by dermal contact and incidental ingestion five days per year for 30 and 5 years, respectively. The health risks associated with surface soil exposure under future assumed residential conditions (350 days/year) ranged from excess cancer risks of $1x10^{-5}$ to $4x10^{-5}$, and HIs of 0.0006 to 0.007.

In the Supplemental Risk Assessment, direct contact with sediment presented cancer risks ranging from $1x10^{-6}$ to $6x10^{-6}$, under current land use, and from $2x10^{-5}$ to $1x10^{-4}$, under assumed future land use conditions. These risks fall within the USEPA target risk range of $1x10^{-6}$ to $1x10^{-4}$.

The health risks from lead in Cold Spring Brook Pond sediment could not be estimated quantitatively in the Supplemental Risk Assessment because of a lack of a USEPA-approved dose/response value for lead. (Lead was not detected in the Cold Spring Brook Pond fish evaluated in the Supplemental Risk Assessment.) The concentrations of lead in sediment were evaluated using the USEPA interim soil cleanup level for lead in residential settings of 500 μg/g. Although the maximum detected concentration of lead in Cold Spring Brook Pond sediment (570 μg/g) was above the soil lead cleanup level, the average concentration (69.5 μg/g) was below the soil lead cleanup level. Exposure to lead in sediment was also predicted to be much less than in a residential setting. Therefore, lead in sediment was not predicted to pose a significant health risk.

Based on the groundwater sampling data from the March and June 1993 sampling rounds (reported in the Final RI Addendum Report), cancer risks (unmodified to account for the uncertainty associated with arsenic) associated with future residential use of the unfiltered groundwater (ranging from $5x10^{-5}$ to $8x10^{-4}$) exceeded the USEPA points of departure and USEPA target risk range. Arsenic

accounted for about 99 percent of the total risk. The cancer slope factor for inorganic arsenic is thought by many to overestimate the true cancer risk. The USEPA Integrated Risk Information System (IRIS) file (December, 1993) on inorganic arsenic states that "the uncertainties associated with ingestion of arsenic are such that estimates could be modified downward as much as an order of magnitude, relative to risk estimates associated with most other carcinogens." If the downward modifying factor of 10 for arsenic were applied to the unfiltered risk estimates, the modified cancer risks would then fall within the Superfund target risk range (at $5x10^{-6}$ to $8x10^{-5}$). It should be noted that even when the concentration of arsenic in groundwater is assumed to be at the federal Maximum Contaminant Level (MCL) of 50 μg/L, the cancer risk associated with the MCL ($1x10^{-3}$) exceeds the Superfund target risk range, and its Hazard Quotient (HQ) (of 5) exceeds one. Two additional analytes, bis(2-ethylhexyl)phthalate and manganese, presented risks above the points of departure. The HQs for manganese (at average concentration of 2,503 μg/L and maximum concentration of 5,700 μg/L) ranged from 16 to 37. Bis(2-ethylhexyl)phthalate (at a maximum concentration of 14 μg/L) presented cancer risks slightly above the point of departure (at $6.5x10^{-6}$).

As discussed in the Supplemental Risk Assessment, the noncancer risks associated with manganese in drinking water may be overestimated. This is due to the uncertainty and limitations of the one epidemiological study upon which the reference dose (RfD) for manganese is based. Failure in the study to control for confounding variables related to the toxic endpoint assessed and failure to estimate total manganese exposure may have resulted in the establishment of an artificially low oral drinking water RfD (i.e., overly-protective).

In comparing the March and June 1993 sampling results to drinking water standards, the maximum detected concentrations from the March and June 1993 sampling rounds of aluminum, iron, and manganese exceeded their Secondary Maximum Contaminant Level (SMCLs). SMCLs are developed to protect against unacceptable aesthetic effects. The federal and state guidelines for sodium in drinking water were also exceeded. The primary MCL for bis-(2-ethylhexyl)phthalate of 6 μg/L was exceeded only by its maximum detected concentration of 14 μg/L; the average concentration of 4 μg/L was below the MCL.

In summary, the Supplemental Human Health Risk Assessment identified the following potential human health risks:

- Future residential use of unfiltered groundwater was interpreted to be under the influence of the landfill and contaminated with arsenic, manganese, sodium, and bis(2-ethylhexyl)phthalate

1.6 SUMMARY OF ECOLOGICAL RISK ASSESSMENT

A supplemental risk assessment was performed at the Cold Spring Brook Landfill to update the ecological risk assessment of the RI Report (E&E, 1993). The supplemental ecological risk assessment integrated information gathered from several phases of investigation at the Group 1A sites in order to determine whether environmental contaminants may pose a risk to ecological receptors. Specifically, the supplemental risk assessment evaluated sediment and fish tissue analytical data that were unavailable when the RI Report was produced. Available surface water analytical data and macroinvertebrate community data were used to characterize risk to aquatic and semi-aquatic receptors. No additional evaluation of surface soils or groundwater was included in the supplemental ecological risk assessment.

The risk assessment of the RI Report indicated that sediment contamination in Cold Spring Brook Pond may pose a risk to ecological receptors (E&E, 1993). Arsenic was found to be the primary risk contributor to aquatic and semi-aquatic biota. Risks to aquatic biota were also predicted from DDD.

To further evaluate ecological risk from the Cold Spring Brook Landfill, analytical chemistry data from 25 shallow sediment samples and nine individual whole fish (representing three species) were evaluated in the supplemental risk assessment. The following paragraphs summarize the results of this supplemental evaluation.

Average and maximum fish tissue analyte concentrations of fish collected from Cold Spring Brook Pond were compared to regional and national data bases by trophic level. The average fish tissue concentration from Cold Spring Brook Pond exceeded regional averages for the following analytes: DDE, iron, manganese, and zinc. This exceedance was statistically significant ($P < 0.05$). The maximum Cold Spring Brook Pond whole body chain pickerel concentrations of mercury and zinc exceeded their respective National Contaminant Biomonitoring Program (NCBMP) 85th percentile concentrations. Fish body weight (and concomitantly trophic status) appears to be a good predictor of mercury contaminant burden in

Cold Spring Brook Pond, with higher trophic level fish species having accumulated higher concentrations of this analyte.

A total of 95 fish representing five families and six species were collected in Cold Spring Brook Pond. The golden shiner (*Notemigonus crysoleucas*) was the predominant fish sampled, comprising 59% of the total population sampled. The chain pickerel, a top predator, and several insectivores were also collected in Cold Spring Brook Pond. Based on the data collected in this study, the species composition and taxa richness of Cold Spring Brook Pond is typical of a southern New England warm water fish community. A gross pathological examination of fish from Cold Spring Brook Pond suggests that the individuals from the population examined are healthy. No tumors, lesions, or other significant abnormalities were observed in any fish examined.

The macroinvertebrate program at Cold Spring Brook Pond was designed to provide baseline information regarding the biota associated with aquatic habitats in the vicinity of the landfill. Although some uncertainty was associated with the use of New Cranberry Pond as the reference pond, the macroinvertebrate community data suggest that Cold Spring Brook Pond may be un-impacted or slightly impacted relative to the reference pond. Within Cold Spring Brook Pond, sampling stations located adjacent to the landfill appear to have lower diversity and abundance of aquatic macroinvertebrates than the station located furthest from the landfill. However, water quality parameters did not appear to be influencing factors in the differences observed between the macroinvertebrate communities at the two ponds or at the different stations within a pond. A statistical analysis between sediment chemistry data and macroinvertebrate abundance was generally inconclusive. However, the analysis did suggest that a group of approximately 15 inorganic COPCs may collectively impact the macroinvertebrate community adversely, with arsenic, cobalt, iron, manganese, and mercury being the COPCs of greatest concern.

Concentrations of DDD, DDE, DDT, anthracene, arsenic, barium, iron, lead, manganese, mercury, nickel, silver, and zinc exceed the available sediment quality criteria and guidelines. The average exposure HQs for these analytes ranged from 1.5 (manganese) to 4.2 (DDT). Reasonable Maximum Exposure (RME) HQs ranged from 1.8 (nickel) to 98.7 (DDT). Because the USEPA sediment quality criteria for DDD, DDE, and DDT may be overly conservative for use at this site, this value was adjusted to reflect more realistic site-specific values. Use

of the adjusted pesticide sediment quality criteria HQ eliminates the risk from DDE for the average exposure scenario and lowers risks from DDD for RME scenarios from over 40 to less than 2.4, and DDT from 98.7 to 5.8.

The average Cold Spring Brook Pond surface water concentrations of iron and manganese slightly exceeded their respective chronic AWQC values; HQs were 1.56 and 1.78 for iron and copper, respectively. Under the RME scenario, the maximum concentrations of copper (HQ = 1.02) and zinc (HQ = 1.8) exceeded their respective acute AWQC values.

For both the average exposure and RME scenarios at Cold Spring Brook Pond, no HQs were greater than 1 for any of the eight evaluated semi-aquatic receptor species; eastern painted turtle, green frog, mallard duck, great blue heron, osprey, muskrat, raccoon, and mink. Summary HIs ranged from less than 0.01 to a high of 2.4, for the green frog.

These findings suggest that COPCs at Cold Spring Brook Pond are not resulting in adverse ecological risk to semi-aquatic receptors. Although low levels of risk to aquatic receptors were predicted, it is unlikely that these risks are present throughout the entire pond. Limited evidence exists indicating that low levels of risk to aquatic receptors may occur in the portions of the pond directly adjacent to the landfill and near the pond outlet (i.e., in hot spots).

2.0 ASSESSMENT OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Compliance with ARARs is one of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) criteria to be evaluated for each of the alternatives screened for detailed analysis in Section 5.0. CERCLA was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act, adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA, but provided extensive amendments to it.

In particular, §121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or circumstances at a site. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured.

The following is an explanation of the terms used throughout this ARARs discussion:

Applicable requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (*52 FR 32496*, August 27, 1987).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (*52 FR 32496*).

Requirements under federal or state law may be either applicable or relevant and appropriate to CERCLA cleanup actions, but not both. However, requirements must be both relevant and appropriate for compliance to be necessary. In the case where both a federal and a state ARAR are available, or where two potential ARARs address the same issue, the more stringent regulation must be selected. The final National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that a standard must be legally enforceable and more stringent than a corresponding federal standard to be relevant and appropriate (55 FR 8756, March 8, 1990). However, CERCLA §121(d)(4) provides several ARAR waiver options that may be invoked, providing that the basic premise of protection of human health and the environment is not ignored. A waiver is available for state standards that have not been uniformly applied in similar circumstances across the state. In addition, CERCLA §121(d)(2)(C) forbids state standards that effectively prohibit land disposal of hazardous substances.

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA §121(e)]. As noted in the ARARs guidance (USEPA, 1988a):

> The CERCLA program has its own set of administrative procedures which assure proper implementation of CERCLA. The application of additional or conflicting administrative requirements could result in delay or confusion.

Substantive requirements pertain directly to the actions or conditions at a site, while **administrative requirements** facilitate their implementation. In order to ensure that CERCLA response actions proceed as rapidly as possible, the USEPA has reaffirmed this position in the final NCP (*55 FR 8756*, March 8, 1990). The NCP defines on-site as "the areal extent of contamination and all areas in very close proximity to the contamination necessary for implementation of the response action." The IAG provides additional guidance on the applicability of permitting requirements to response actions at Fort Devens (USEPA, 1991). The USEPA recognizes that certain of the administrative requirements, such as consultation with state agencies and reporting, are accomplished through the state involvement and public participation requirements of the NCP.

The provisions of the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000 (November 19, 1993) are mostly administrative in nature and, therefore, do not have to be complied with in connection with the response action selected for the Cold Spring Brook Landfill Operable Unit. Further, the MCP contains a specific provision (310 CMR 40.0111) for deferring application of the MCP at CERCLA sites. 310 CMR 40.0111(1)(a) provides that response actions at CERCLA sites shall be deemed adequately regulated for purposes of compliance with the MCP, provided the Massachusetts Department of Environmental Protection (MADEP) concurs in the CERCLA record of decision.

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding, but may serve as useful guidance for remedial actions. These are not potential ARARs, but are "to-be-considered" (TBC) guidance. These guidelines may be addressed as deemed appropriate.

ARARs are divided into the three categories listed below.

- **Location-specific ARARs** "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (*53 FR 51394*). In determining the use of location-specific ARARs for selected remedial actions at CERCLA sites, one must investigate the jurisdictional prerequisites of each of the regulations. Basic definitions and exemptions must be analyzed on a site-specific basis to confirm the correct application of the requirements.

- **Chemical-specific ARARs** are usually health- or risk-based standards that limit the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels, or the basis for calculating such levels. For example, groundwater MCLs may provide the necessary cleanup goals for sites with contaminated groundwater. There are no direct chemical-specific ARARs for soils. Chemical-specific ARARs for the site may also be used to indicate acceptable levels of discharge in determining treatment and disposal requirements, and to assess the effectiveness of future remedial alternatives.

- **Action-specific ARARs** set controls or restrictions on particular kinds of activities related to the management of hazardous waste (53 *FR* 51437). Selection of a particular remedial action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies, as well as specific environmental levels for discharged or residual chemicals. Action-specific ARARs are established under the Resource Conservation and Recovery Act (RCRA), the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, the Toxic Substances Control Act, and other laws.

Many regulations can fall into more than one category. For example, many location-specific ARARs are also action-specific because they are triggered if remedial activities affect site features. Likewise, many chemical-specific ARARs are also location specific.

The Occupational Safety and Health Administration (OSHA) has promulgated standards for protection of workers at hazardous waste operations at RCRA or CERCLA sites (29 CFR Part 1910). These regulations are designed to protect workers who would not be exposed to hazardous waste. Federal construction activities involving no potential for hazardous substance exposure are covered by the OSHA standards found at 29 CFR Part 1926. USEPA requires compliance with the OSHA standards in the NCP (40 CFR 300.150), not through the ARAR process. Therefore, the OSHA standards are not considered as ARARs. They are discussed in the site-specific Health and Safety Plan.

Section 5.0 contains an alternative-specific discussion of ARARs.

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

General response and remedial action objectives form the basis for identifying remedial technologies and developing remedial alternatives. This section identifies general response and remedial action objectives, and potential general response actions to meet those objectives. Remedial technologies considered implementable, and which also address the remedial action objectives and general response actions, are identified. Candidate remedial technologies are then screened based on their applicability to site and waste characteristics. The purpose of the screening is to produce an inventory of suitable technologies that can be assembled into remedial alternatives capable of mitigating actual or potential risks at the Cold Spring Brook Landfill Operable Unit.

The Cold Spring Brook Landfill Operable Unit includes all media and contamination of concern at Cold Spring Brook Landfill, including groundwater, source area soils/solid wastes, and pond sediments.

3.1 IDENTIFICATION OF REMEDIAL RESPONSE OBJECTIVES

Response objectives are site-specific, qualitative cleanup objectives based on the nature and extent of contamination, the resources currently or potentially threatened, and the potential for human and environmental exposure. For the Cold Spring Brook Landfill Operable Unit, response objectives were formulated based on environmental concerns defined in the environmental contamination assessment, risk assessment, and ARARs analysis. Response objectives are used to develop remedial action objectives and appropriate remedial alternatives.

Based on the environmental contamination assessment in the RI and RI Addendum Reports, the following general response objectives were identified for the Cold Spring Brook Landfill Operable Unit:

- Protect potential residential receptors from exposure to groundwater having chemicals in excess of MCLs and health-based ARARs.
- Prevent sediments from acting as an ecological exposure point with contaminant concentrations in excess of ecological concern.

- Minimize alteration and potential impacts to Cold Spring Brook Pond and associated wetland.

3.2 PRELIMINARY REMEDIATION GOALS

Preliminary Remediation Goals (PRGs) are numerical goals for site cleanup that are intended to be protective and to comply with ARARs. PRGs are based both on risk assessment and on ARARs. PRGs for the Cold Spring Brook Landfill Operable Unit were developed following the USEPA guidance document entitled *Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part B, Development of Risk Based Preliminary Remediation Goals)*, Interim, December 1991 (RAGS Part E) (USEPA, 1991c) and OSWER Directive 9355.0-30, *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (USEPA, 1991b). The first step in developing human health PRGs is to identify those environmental media that, in the baseline risk assessment, present either a cumulative current or future cancer risk greater than 1×10^{-4} or a cumulative noncarcinogenic HI greater than 1, based on RME assumptions. The next step is to identify COPCs within the media that present cancer risks greater than 1×10^{-6} or an HQ greater than 1. Following identification of media of concern and COPCs, PRGs are developed and refined by considering the following:

- ARARs
- exposure factors
- technical factors, and
- uncertainty factors

3.2.1 Human Health PRGs

Under assumptions of current land use, the baseline risk assessment did not identify media of concern or COPCs presenting cancer risks or HIs greater than USEPA criteria. Under assumptions of future land use, residential use of groundwater at Cold Spring Brook Landfill does present potential health risks above the criteria (Tables 3-1 and 3-2).

The consumption of unfiltered groundwater from evaluated wells at Cold Spring Brook Landfill presents cancer risks above 1×10^{-4}. Following USEPA guidance, for those media with cancer risks above 1×10^{-4}, the next step is to identify those

COPCs within the media that present cancer risks above $1x10^{-6}$. Arsenic and bis(2-ethylhexyl)phthalate are the only two COPCs that meet this criterion.

Similarly, for noncancer risks under future use assumptions, only the risks from residential groundwater use exceed the criterion. As seen in Table 3-2, the HIs for both the adult and child receptors for unfiltered and filtered groundwater exceed 1. As with carcinogens, USEPA guidance says that within those media with noncancer risks above 1, the next step is to identify those COPCs within the medium whose HQ exceeds 1. Manganese and arsenic are the only COPCs meeting this criterion.

The COPCs aluminum, iron, and sodium did not present cancer risks or HIs greater than USEPA criteria; however, comparison of detected groundwater concentrations to drinking water standards and guidelines indicates that they were detected at concentrations above their respective standards or guidelines (Table 3-3). For aluminum and iron, average and maximum concentrations exceeded their SMCLs. For sodium, the maximum concentration exceeded the USEPA drinking water guideline. Aluminum was not detected in the filtered samples, although iron remained in the filtered samples at concentrations above the SMCL. In the filtered samples, the concentrations of sodium fell below the guideline.

For arsenic and bis(2-ethylhexyl)phthalate, a drinking water standard exists that can serve as an ARAR-based PRG (see Table 3-3). The average and maximum concentrations detected in the wells at Cold Spring Brook Landfill are also shown.

For arsenic, it is important to note that, although its baseline risks exceed the 10^{-6} criterion, the maximum detected concentration is below the federal MCL of 50 μg/L. The baseline risk assessment points out that even when the concentration of arsenic in groundwater is at the federal MCL, the cancer risk associated with the MCL (10^{-3}) exceeds the criterion of 10^{-6}.

Bis(2-ethylhexyl)phthalate was detected in two of four samples, in the supplemental RI Rounds 1 and 2. It was not detected in RI sampling, as reported in the RI Report. Although the maximum detected concentration exceeds the MCL, its average concentration is below the MCL.

For manganese, background concentrations at Fort Devens exceed the SMCL. In addition, the toxicity of manganese is also not well defined. At this time, there is no MCL or Maximum Contaminant Level Goal (MCLG), and one is not expected until 1995. The MCLG shown in the baseline risk assessment no longer exists and the oral toxicity value used in the baseline risk assessment is posted in USEPA's IRIS database as pending change. Therefore, the background concentration of 291 μg/L is proposed as a PRG.

Concentrations of aluminum and iron both exceed SMCLs and background. Therefore, background concentrations are proposed as PRGs. The proposed PRG for sodium is the federal health advisory of 20,000 μg/L.

3.2.2 Ecological PRGs

The ecological risk assessment predicted that certain primary benthic receptors, (e.g., certain fish and macroinvertebrates) may be at risk from lead and arsenic in Cold Spring Brook Pond sediments. As described in the ecological risk assessment, the results of the macroinvertebrate study conducted at this site were inconclusive and did not provide sufficient resolution to assist in the development of PRGs for either of these inorganics. No definite relationship between arsenic and lead sediment concentrations and macroinvertebrate community structure and diversity was established. Therefore, the macroinvertebrate study provides neither evidence of impacts at Cold Spring Brook Pond, nor a foundation for development of PRGs.

It is important to note that no site-specific information exists regarding the toxicity or bioavailability of lead or arsenic. Although evidence exists that pore water concentrations of metals in sediments correlate to biological effects, no comprehensive partitioning theory currently exists that predicts free, dissolved concentrations of toxic metals (Ankley et al., 1993). It is likely that abiotic factors such as organic carbon, conductivity, and sulfides may greatly reduce the bioavailability of arsenic in Cold Spring Brook Pond sediments, and that sulfides, pH, and calcium may affect the bioavailability of lead.

3.2.2.1 Candidate Ecological PRGs. In the absence of site-specific information regarding bioavailability and toxicity, literature sources were used to establish a range of candidate arsenic and lead PRGs for this site. Table 3-4 summarizes

candidate sediment PRGs for lead and arsenic in Cold Spring Brook Pond sediments.

Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. These guidelines were developed for evaluating sediments throughout Ontario, especially in the Great Lakes (Persaud et al., 1992). These biologically-based guidelines have been developed to protect sediment-dwelling (benthic) receptor species. Based on chronic, long-term effects of contaminants on benthic organisms, the Ontario sediment quality guidelines establish three levels of eco-toxic effects:

- No Effect Level (not available for metals)
- Lowest Effect Level
- Severe Effect Level

The No Effect Level is designed to protect against biomagnification through the food chain; since these effects are most common with non-polar, hydrophobic organics, No Effect Levels for inorganics have not been provided in the Ontario sediment quality guidelines (Persaud et al, 1992).

The Lowest Effect Level is intended to represent the concentration of a contaminant that can be tolerated by the majority of benthic organisms. The Severe Effect Level is intended to represent the sediment concentration that would be detrimental to the majority of benthic species.

- **Arsenic.** The Lowest Effect Level for arsenic is 6 $\mu g/g$. This value is within the range of naturally occurring background sediment concentrations at Fort Devens (E&E, 1994) and is therefore not considered a suitable PRG. PRGs should not be established below background concentrations for naturally occurring trace elements).

  For arsenic, the Severe Effect Level is 33 $\mu g/g$. The Severe Effect Level represents the sediment concentration that would be detrimental to the majority of benthic species evaluated in the Great Lakes studies reviewed in the Ontario sediment quality guidelines. It is unknown whether the Severe Effect Level under- or over-estimates risk at Cold Spring Brook Pond. The arsenic Severe Effect Level concentration is above the range of background arsenic

concentrations detected in sediments at Fort Devens (0.8 to 26 μg/g); therefore, in the absence of site-specific toxicity or bioavailability information, the Severe Effect Level should be considered a candidate PRG for arsenic.

- **Lead**. For lead, the Lowest Effect Level is 31 μg/g. This concentration is above the range of background lead concentrations in Fort Devens sediments (3.5 to 12.5 μg/g); therefore, in the absence of site-specific toxicity or bioavailability information, the Lowest Effect Level should be considered a candidate PRG for lead.

  The Severe Effect Level for lead is 250 μg/g. The Severe Effect Level represents the sediment concentration that would be detrimental to the majority of benthic species evaluated in the Great Lakes studies reviewed in the Ontario sediment quality guidelines. It is unknown whether the Severe Effect Level under- or over-estimates risk at Cold Spring Brook Pond. The lead Severe Effect Level concentration is above the range of background lead concentrations detected in Fort Devens sediments (3.5 to 12.5 μg/g); therefore, in the absence of site-specific toxicity or bioavailability information, the Severe Effect Level should be considered a candidate PRG for lead.

The Potential for the Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. The National Oceanic and Atmospheric Administration (NOAA) has developed biological effects-based guidelines for evaluating sediment contaminant data (NOAA, 1990). Although this NOAA study is designed primarily for evaluating the toxicity of marine and estuarine sediments, USEPA Region I has suggested that it may also be used as a source of information for the evaluation of freshwater sediments at hazardous waste sites. NOAA guidelines, however, are not federal criteria, and are only intended for purposes of qualitative assessment of sediments. Considerable uncertainty is associated with using these values as PRGs.

The NOAA (1990) study involves a simple evaluation to identify the following three ranges of concentrations for evaluated analytes (Long and MacDonald, 1992):

- No-Effects Range
- Possible-Effects Range
- Probable-Effects Range

The Effects Range-Low value (ER-L) of NOAA (1990) represents the 10th percentile of concentrations of contaminants in sediments with observed (or predicted) effects. This lower guideline is assumed to represent the concentration below which toxic effects rarely occur in the NOAA (1990) study (i.e., the No-Effects Range). The Effects Range-Median value (ER-M) of NOAA (1990) represents the 50th percentile of concentrations of contaminants in sediments with observed (or predicted) effects. Concentrations of contaminants above the ER-M represent the concentration above which toxic effects occurred (i.e., the Probable-Effects Range). Concentrations between the ER-L and the ER-M represent the range of concentrations in which effects occasionally occurred (i.e., the Possible-Effects Range).

- **Arsenic**. The NOAA ER-L for arsenic was established at 33.0 μg/g. The NOAA degree of confidence in this ER-L is relatively low, due to the poor consistency and clustering around the available values at the low end of the evaluated range (NOAA, 1990).

  The NOAA ER-M for arsenic is 85.0 μg/g. The NOAA degree of confidence in the ER-M is moderate, since the ER-M was supported by several observations and is roughly equivalent to an apparent effects threshold for arsenic.

  It is unknown whether the NOAA values under- or over-estimate risk at Cold Spring Brook Pond. Both the ER-L and the ER-M are above the range of background arsenic concentrations detected in sediment at Fort Devens (0.80 to 26.0 μg/g); therefore, in the absence of site-specific toxicity or bioavailability information, both the NOAA ER-L and ER-M should be considered candidate PRGs for arsenic.

- **Lead**. The NOAA ER-L for lead was established at 35.0 μg/g. The NOAA degree of confidence in this ER-L is moderate. Although a relatively large data set was evaluated for lead, no information was available regarding lead speciation in the NOAA study.

The NOAA ER-M for lead is 110.0 $\mu g/g$. The NOAA degree of confidence in the ER-M is high; this value was supported by a small cluster of data from a number of different studies.

It is unknown whether the NOAA lead values under- or over-estimate risk at Cold Spring Brook Pond. Both the ER-L and the ER-M are above the range of background lead concentrations detected in sediment at Fort Devens (3.5 to 12.5 $\mu g/g$); therefore, in the absence of site-specific toxicity or bioavailability information, both the NOAA ER-L and ER-M should be considered candidate PRGs for lead.

3.2.2.2 Selection of Ecological PRGs. Remediation of lead and arsenic in Cold Spring Brook Pond sediments could result in ecological impacts associated with habitat alteration. Ecological impacts could include:

- destruction of wetland vegetation;
- alteration of wetland hydrology;
- alteration of the ability of the pond to provide wildlife habitat, including food, shelter, over-wintering, and breeding areas for wildlife;
- alteration of the ability of the pond to provide fish habitat;
- alteration of the ability of the pond to perform wetlands functions, including flood water storage, surface water purification, sediment pollution absorption, and sediment load deposition.

If wetlands restoration is required in order to justify risks associated with habitat loss associated with remediation, the associated short-term loss of wetlands functions and values during the recovery period must also be considered.

A recent USEPA Science Advisory Board (USEPA, 1990) review of relative ecological risks indicates that environmental protection strategies should prioritize remedial options for the greatest overall risk reduction. USEPA (1990) recommends that the relative risks of remedial strategies be considered,

particularly as they relate to natural ecosystem destruction; habitat alteration may result in greater relative risk than environmental contamination. Hull et al. (1993) identify three categories for ecological (and public health) risk: (1) *de minimis* (i.e., risks that would not require remediation because they are considered trivial), (2) *de manifestis* (i.e., sites that would require remediation for ecological risk unless a compelling case can be made that remediation could conflict with protection of human health, or sites where remediation is clearly required due to human health risk), and (3) intermediate (i.e., risks that fall between *de minimis* and *de manifestis*. According to Hull et al. (1993), risks in the intermediate category are not always so compelling as to require immediate remediation, but require balancing of a number of factors, including costs, health risks, and the risks associated with remediation (e.g., habitat destruction). Based on the lack of human health risk from sediment exposure at Cold Spring Brook Pond, and the uncertainties associated with the ecological risk assessment (ABB-ES, 1993b), it is likely that Cold Spring Brook Pond falls into the intermediate category of Hull et al. (1993).

Because of the lack of site-specific information regarding lead and arsenic toxicity and bioavailability in Cold Spring Brook Pond sediments, the technical difficulties associated with successful wetland restoration, and the ecological and financial costs associated with remediation, ABB-ES does not recommend developing a remedial alternative based solely on the lower end of the range of numerical PRGs. Rather, the preferred remedial alternative should consider Cold Spring Brook Pond as a whole, and should evaluate reducing the risks associated with the two identified hot spots in the pond.

ABB-ES recommends limiting sediment dredging to the two identified hot spots at Cold Spring Brook Pond. Area I includes approximately 7,100 square feet at the small cove along the southern pond shore near CSD-92-07X as well as the peninsula that defines it. Area I includes all the area enclosed by the contour for the lead NOAA ER-L concentration of 35 $\mu g/g$, and approximately two-thirds of the area enclosed by the contour for the arsenic NOAA ER-L concentration of 33 $\mu g/g$. ABB-ES believes, however, that the contouring routine may have overestimated the area included by the arsenic contours and that the 7,100 square feet in Area 1 includes all the area exceeding the arsenic ER-L of 33 $\mu g/g$. The contouring routine may have overestimated the area because it does not recognize the presence of the peninsula that defines the north side of the cove. Review of the sediment analytical data in Appendix B shows how strongly the high arsenic

and lead concentrations are associated with samples collected from the peninsula and cove. Samples collected outside of this area (i.e., CSD-92-10X, CSB-SE-03, and CSD-SE-04) all had arsenic and lead concentrations below the NOAA ER-L.

Area II includes approximately 11,000 square feet at the pond outlet. Area II includes the area within the contours for the NOAA ER-L concentrations for arsenic and lead of 33 and 35 $\mu g/g$, respectively.

At Area I, sediment excavation to a depth of three feet is proposed for approximately one-forth of the area, and excavation to two feet is proposed for approximately one-half of the removal area. A one-foot depth is proposed for the remaining area. At Area II, excavation of sediment to a depth of one foot is proposed, with the exception of sediments within an approximate 20 foot radius of CSM-92-01 where excavation will be two feet deep. The total excavated volume at Area I would be approximately 460 cubic yards (cy) and at Area II 430 cy.

3.3 Remedial Action Objectives

Remedial action objectives are medium- or operable unit-specific, quantitative goals defining the extent of cleanup required to achieve response objectives. They specify contaminants of concern, exposure routes and receptors, and PRGs. In the case of groundwater, they also include a restoration time frame. Remedial action objectives are used as the framework for developing remedial alternatives. The remedial action objectives are formulated to achieve the overall goal of USEPA of protecting human health and the environment. Table 3-5 lists remedial action objectives for the Cold Spring Brook Landfill Operable Unit.

3.4 General Response Actions

General response actions describe categories of remedial actions that may be employed to satisfy remedial action objectives. General response actions provide the basis for identifying specific remedial technologies.

Applicable general response actions to meet groundwater remedial action objectives are listed in Table 3-6 in conjunction with potential remedial technologies. Although the risk assessment evaluated potential risk associated

with future residential exposure to groundwater at Cold Spring Brook Landfill, the landfill's potential effect on groundwater quality at Patton Well located approximately 600 feet west of the landfill is also a concern. Because of the hydrogeologic location of Cold Spring Brook Landfill (see Subsection 1.3), potential off-site migration of contamination in groundwater is not expected, except possibly toward Patton Well at the western end of the landfill. Water quality at Patton Well has remained acceptable, however, even though any adverse effects from the landfill should have been apparent many years ago. With these considerations in mind, general response actions for groundwater focus on preventing future residential use of groundwater immediately adjacent to the landfill and monitoring for potential future migration of contaminants in groundwater from the landfill toward Patton Well.

Although the risk assessment did not identify potential risks greater than USEPA threshold criteria for source area soils/solid wastes, several discarded drums have been observed at the landfill and leaching of landfill materials represents a potential source of groundwater contamination. Table 3-7 presents potential source area soils/solid waste technologies to remove discarded drums and control leaching of landfill materials.

Table 3-8 contains potential technologies for remediating hot spot areas of sediment contamination.

General response actions for groundwater, sediments, and source area soils/solid wastes at the Cold Spring Brook Landfill Operable Unit include the following: No Action, Limited Action, Containment, Removal, Treatment, and Disposal. These general response actions are in accordance with recommendations made in USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988b).

3.5 Technology Identification

Categories of remedial technologies and specific process options were identified based on a review of literature, vendor information, performance data, and experience in developing other FSs under CERCLA. Of these process options, 19 were selected as being potentially applicable to attaining the preliminary remedial

response objectives. Tables 3-9 through 3-11 provide descriptions for groundwater, source area soils/solid waste, and sediment process options.

3.6 TECHNOLOGY SCREENING

The technology screening process reduces the number of potentially applicable technologies and process options by evaluating factors that may influence process option effectiveness and implementability. This overall screening is consistent with the guidance for conducting FSs under CERCLA (USEPA, 1988b).

The screening process assesses each technology or process option for its probable effectiveness and implementability with regard to site-specific conditions, known and suspected contaminants, and affected environmental media. The effectiveness evaluation focuses on: (1) whether the technology is capable of handling the estimated areas or volumes of media and meeting the contaminant reduction goals identified in the remedial action objectives; (2) the effectiveness of the technology in protecting human health during the construction and implementation phase; and (3) how proven and reliable the technology is with respect to the contaminants and conditions at the site. Implementability encompasses both the technical and institutional feasibility of implementing a technology. Effectiveness and implementability are incorporated into two screening criteria: waste- and site-limiting characteristics.

Waste-limiting characteristics largely establish the effectiveness and performance of a technology; site-limiting characteristics affect implementability of a technology. Waste-limiting characteristics consider the suitability of a technology based on contaminant types, individual compound properties (e.g., volatility, solubility, specific gravity, adsorption potential, and biodegradability), and interactions that may occur between mixtures of compounds (e.g., reactions and increased solubility). Site-limiting characteristics consider the effect of site-specific physical features, including topography, buildings, underground utilities, available space, and proximity to sensitive operations on the implementability of a technology. Technology screening based on waste- and site-limiting characteristics serves a two-fold purpose of screening out technologies whose applicability is limited by site specific waste or site considerations, while retaining as many potentially applicable technologies as possible.

Tables 3-12 through 3-14 summarize the technology screening phase for the Cold Spring Brook Landfill Operable Unit at Fort Devens. Technologies and process options judged ineffective or not implementable were eliminated from further consideration.

Table 3-15 summarizes the groundwater, source area soils/solid wastes, and pond sediment technologies retained for further consideration. The technologies retained following screening represent an inventory of technologies considered most suitable for the Cold Spring Brook Landfill Operable Unit. Technologies retained in this section may be used to develop remedial alternatives. Treatability studies may be required prior to final selection to confirm the effectiveness of a given technology or process option.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

In this section, technically feasible technologies and process options retained following the screening described in Section 3.0 are combined to form remedial action alternatives. Alternatives were developed to attain the remedial action objectives discussed in Section 3.0 for the Cold Spring Brook Landfill Operable Unit. The alternatives include: (1) No Action; (2) Limited Action; (3) Containment; and (4) Removal.

The developed remedial alternatives were then screened with respect to the criteria of effectiveness, implementability, and cost to meet the requirements of CERCLA and the NCP. The objective of this screening step is to eliminate impractical alternatives or higher cost alternatives (i.e., order of magnitude cost differences) that provide little or no increase in effectiveness or implementability over their lower cost counterparts. The No Action Alternative will not be evaluated according to screening criteria; it will pass through screening to be evaluated during the detailed analysis as a baseline for the other retained alternatives (USEPA, 1988b). The three criteria used for screening the alternatives are as follows:

Effectiveness. Each alternative was judged for its ability to effectively protect public health and the environment by reducing the toxicity, mobility, or volume of contaminants. Both short- and long-term effectiveness were screened. Short-term effectiveness involves reducing existing risks to the community and workers during the construction and implementation period, the alternative's ability to meet remedial action objectives, and the time frame required to achieve remedial action objectives. Long-term effectiveness, which applies after remedial action objectives have been attained, considers the magnitude of the remaining residual risk due to untreated wastes and waste residuals, and the adequacy and reliability of specific technical components and control measures. Effectiveness also considers adverse environmental impacts during construction and implementation of the alternative, and the availability of mitigating measures to minimize impacts.

Implementability. Each alternative was evaluated in terms of technical and administrative feasibility. In the assessment of short-term technical feasibility, availability of a technology for construction or mobilization and operation, as well as compliance with action-specific ARARs during the remedial action were

considered. Long-term technical feasibility considered the ease of operation and maintenance (O&M), replacement, and monitoring of technical controls of residuals and untreated wastes, technology reliability, and ease of undertaking additional remedial actions. Administrative feasibility for implementing a given technology addressed coordination with other agencies. Implementability also considers the availability of required services and trained specialists or operators.

Cost. The final criterion for initial screening of alternatives is the cost associated with the given remedy. Relative capital and O&M costs are discussed at this stage, as well factors influencing cost sensitivity. Potential liability associated with untreated waste and treatment residuals is also discussed. Absolute accuracy of cost estimates during screening is not essential. The focus should be to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives will be sustained as the accuracy of cost estimates improves beyond screening (USEPA, 1988b). Cost estimates for alternatives screening are based on generic unit costs, vendor information, cost-estimating guides, and prior similar estimates. Cost estimates for items common to all alternatives or indirect costs do not normally warrant substantial effort during the alternative screening phase (USEPA, 1988b). Actual detailed cost estimates are presented in the detailed analysis of retained alternatives in Section 5.0 and Appendix A.

Alternative Evaluation. For each alternative, a matrix was developed highlighting the alternative's advantages and disadvantages with respect to effectiveness, implementability, and cost. The alternative evaluation matrix presents a clear, concise procedure for screening potential remedial action alternatives. Based on this matrix, a decision was made to either retain the alternative for detailed analysis or eliminate it from further consideration.

4.1 DEVELOPMENT OF ALTERNATIVES FOR COLD SPRING BROOK LANDFILL OPERABLE UNIT

Four remedial alternatives were developed to address remedial action objectives presented in Table 3-5 for the Cold Spring Brook Landfill Operable Unit. In assembling these alternatives, general response actions and technology process options chosen to represent the various technology types for the medium of concern are combined to form alternatives for the site as a whole (USEPA,

1988b). Alternatives were developed to provide a range of options consistent with USEPA RI/FS guidance (USEPA, 1988b). These alternatives are:

- Alternative CSBL-1: No Action
- Alternative CSBL-2: Drum Removal/Hot Spot Sediment Removal
- Alternative CSBL-3: Landfill Capping/Drum and Hot Spot Sediment Removal
- Alternative CSBL-4: Landfill Excavation/Drum and Hot Spot Sediment Removal

The volume of material that would need to be removed if Cold Spring Brook Landfill were excavated is estimated to be approximately 100,000 cy. This volume was calculated by summing incremental volumes based on landfill cross sections drawn at 100 foot intervals along Patton Road plus 2 feet of overexcavation below the landfill. This resulted in an estimated volume of 96,000 cy which was rounded to 100,000 cy. A two-to-one side slope was left along Patton Road based on the interpretation of terrain conductivity and magnetic survey data that debris does not extend south of Patton Road (E&E 1993) and that debris was not used as a subbase for reconstruction of Patton Road. In addition, there are approximately 14 55-gallon drums visible at the landfill, including several located along the southern edge of Cold Spring Brook Pond. The estimated volume of sediment in Cold Spring Brook Pond requiring removal in Alternatives CSBL-2, -3, and -4 is approximately 900 cy. However, because of uncertainties in estimating the volume, the cost estimate of this FS is based on removal of 1,200 cy.

4.1.1 Alternative CSBL-1: No Action

No actions would be taken at the Cold Spring Brook Landfill to reduce potential for future releases to groundwater or to Cold Spring Brook Pond sediment. Sediments exceeding criteria or guidelines would not be removed or treated, allowing potential human and ecological exposures to continue. Two new groundwater monitoring wells, installed at the western end of the landfill, along with five existing wells, would be monitored for potential contamination migration from the landfill (Figure 4-1). This alternative is included as a baseline to which other alternatives will be compared.

4.1.2 Alternative CSBL-2: Drum Removal/Hot Spot Sediment Removal

Alternative CSBL-2 includes institutional controls, storm water drainage improvements, drum removal, hot spot removal of sediments from Cold Spring Brook Pond landfill, bank and surface improvements and environmental monitoring.

The area including Cold Spring Brook Landfill and Cold Spring Brook Pond would be zoned to restrict residential development, and deed restrictions would be implemented to prohibit placement of drinking water wells.

Sediment removal is proposed at two areas in Cold Spring Brook Pond (Figure 4-2). Area I includes sample points CSD-92-07X, CSD-92-08X and CSD-92-09X along the southern pond edge. Area II includes sample points CSD-92-01X and CSD-92-02X near the pond outlet.

Excavated sediments would require Toxicity Characteristic Leaching Procedure (TCLP) testing; sediments that pass the TCLP test would be disposed in an on-site solid waste consolidation facility, if one is available, or at an off-site facility. The addition of a sorbent or solidifying agent may be necessary to eliminate free water prior to transport and disposal. Sediments that fail the TCLP test would be disposed in an off-site RCRA treatment, storage, and disposal (TSD) facility. The excavated area would be restored in accordance with a Wetlands Restoration Specification (WRS), discussed in greater detail in Subsection 5.2, to allow recovery of indigenous plant species in the affected area.

The 55-gallon drums found in 1987 along the southern edge of Cold Spring Brook Pond would be removed and disposed of properly. The approximate location of these drums is shown in Figure 4-2.

Debris protrudes from the landfill surface and bank at several locations creating a potential physical hazard to site visitors, such as bird watchers, wildlife observers, and the occasional fisherman. In addition, depressions occur in the partially graded surface that could also pose a potential hazard. A bank and surface improvement program would be implemented as part of this alternative to remove or cover protruding debris and fill depressions. Storm water drainage improvements that would divert water away from Cold Spring Brook Landfill would be considered.

Alternative CSBL-2 proposes a long-term environmental monitoring program that includes groundwater monitoring, sediment monitoring, and biomonitoring. Five-year reviews would be conducted to evaluate whether Alternative CSBL-2 continues to protect public health and the environment.

4.1.3 Alternative CSBL-3: Landfill Capping/Drum and Hot Spot Sediment Removal

This alternative is a containment option that includes construction of a low-permeability cap over the Cold Spring Brook Landfill, and incorporates all components of Alternative CSBL-2, including drum removal and hot spot sediment removal.

As with Alternative CSBL-2, institutional controls in the form of deed and land use restrictions would be implemented with Alternative CSBL-3 so, at the time of property transfer from the U.S. Army to the new owner, this land could not be developed for residential use.

Drum and hot spot sediment removal are proposed as described in Alternative CSBL-2. Because wastes would remain on site, long-term groundwater, sediment, and biomonitoring and five-year reviews would be required at the site.

4.1.4 Alternative CSBL-4: Landfill Excavation/Drum and Hot Spot Sediment Removal

Alternative CSBL-4 would include excavation of the Cold Spring Brook Landfill and some of the components of Alternative CSBL-2; including drum removal and hot spot sediment removal. The site would be restored in accordance with a WRS (discussed in greater detail in Subsection 5.2) to allow recovery of indigenous plant species in the affected area.

Evidence and reports indicate that material within the Cold Spring Brook Landfill is primarily construction/demolition debris and is nonhazardous. The excavated construction/demolition debris would be consolidated at a suitable alternate Fort Devens location meeting the technical requirements of Massachusetts Solid Waste Management Regulations 310 CMR 19.000. If landfill debris is suitable, it may be possible to recover materials for beneficial use according to 310 CMR 19.062. Excavation of sediment from Cold Spring Brook Pond would be implemented as

described in Alternatives CSBL-2 and CSBL-3. Removal of the landfilled wastes would prevent potential future contributions of contamination from the landfill to the sediments and potential future releases to groundwater.

Because Alternative CSBL-4 proposes source removal, a short-term groundwater, sediment, and biomonitoring program would be implemented to evaluate the effectiveness of this alternative. Along with the environmental monitoring program, annual site inspections would be conducted to evaluate recovery at the site. Results of environmental monitoring and annual site inspections would be incorporated into a five-year review. It is anticipated that once the monitoring and inspection program shows that no further contamination of sediments or contamination of groundwater has occurred, the site would be released for unrestricted use and exposure.

4.2 Screening of Alternatives for Cold Spring Brook Landfill Operable Unit

Based on the screening approach presented at the beginning of this section, a brief discussion of alternative screening is presented for each of the remedial alternatives developed for the Cold Spring Brook Landfill Operable Unit. Screening matrices for each alternative are presented in Tables 4-1 through 4-3, and a screening summary is presented in Table 4-4.

Alternative CSBL-1, the No Action Alternative, was not evaluated by screening criteria. It will be retained for further evaluation in the detailed analysis as a baseline for comparison with other retained alternatives.

4.2.1 Alternative CSBL-2: Drum Removal/Hot Spot Sediment Removal

Description. This alternative would include land use restrictions to reduce potential future residential exposure to groundwater. In addition, sediments at two hot spot locations in Cold Spring Brook Pond and drums located at the edge of the landfill will be removed and disposed of properly. Landfill bank and surface improvements would be implemented to reduce potential physical hazards at the site. Environmental monitoring of groundwater, sediments, and biota will be conducted to evaluate the site's impact over time. Five-year site reviews would be conducted because landfilled materials would remain on site.

Effectiveness. Alternative CSBL-2 would provide protection of human health and the environment by implementing institutional controls, and removing drums and contaminated sediments from Cold Spring Brook Pond, thereby reducing the potential for human and ecological exposure to site-related contamination. No reduction in the toxicity, mobility, or volume of landfilled materials would be achieved. Because landfilled materials would not be removed, potential future releases to groundwater and Cold Spring Brook Pond sediment could occur and the potential would exist for future remedial action.

Drum and sediment removal activities would adversely affect benthic organisms in the removal area and could potentially adversely affect benthic and other aquatic organisms in the pond and associated wetland. Actual and potential adverse effects would be mitigated through an approved wetland restoration program. Environmental monitoring (i.e., groundwater, sediment, and biomonitoring) would assist in meeting remedial action objectives by enabling assessment of whether additional future groundwater, source area, or sediment remedial actions are needed, while limiting current pond and wetland impacts. Results of environmental monitoring would be incorporated into the five-year reviews. Potential for short-term worker exposure to landfilled materials and contaminated sediment would exist during and drum and sediment removal.

Implementability. Zoning and deed restrictions on Army property would be relatively easy to implement. Sediment and drum removal are the only construction activities that would occur for Alternative CSBL-2. These technologies are well developed, reliable, and would be easily implemented. Access for sediment removal equipment may be difficult because of the steep landfill slope and wet conditions along the toe of the slope. Sediment, and possibly drum removal activities would affect wetlands and habitat in the vicinity of Cold Spring Brook Landfill and would trigger several action-specific ARARs. Prior to implementing this alternative, the remedial contractor would need to inform federal and Commonwealth regulators of details concerning planned remedial activities, including wetland restoration activities, and consider regulatory comments during finalization of plans. The potential adverse effects on wetlands and habitat will be a significant concern in the detailed evaluation of this alternative. Under CERCLA, the remedial contractor would not be required to obtain licenses and permits for on-site activities. Implementation of this alternative would not prevent or reduce ease of undertaking additional remedial actions.

Cost. Estimated capital costs for Alternative CSBL-2 include costs for implementing institutional controls, site access restrictions, sediment and drum removal, transportation and disposal of drums and sediments at off-site solid waste and RCRA landfills, and installing two new groundwater monitoring wells. Annual O&M costs are primarily influenced by groundwater and environmental monitoring costs which are a component of all alternatives. The total cost of this alternative is relatively low; however, there is potential long-term liability associated with leaving landfill debris in place.

Conclusion. This alternative will be retained for detailed analysis (see Table 4-1). Alternative CSBL-2 will meet remedial action objectives by implementing institutional controls, removing drums, and removing hot spot sediments, and long-term monitoring. Long-term groundwater and sediment monitoring will assess whether contaminants exceed concentrations of concern in the future. Impacts and alterations to the pond and wetland area would be low.

4.2.2 Alternative CSBL-3: Landfill Capping/Drum and Hot Spot Sediment Removal

Description. Alternative CSBL-3 is a containment option that would include capping the Cold Spring Brook Landfill with a low-permeability cover, and the same drum removal, hot spot removal of contaminated sediments from Cold Spring Brook Pond, site access and land use restrictions, environmental monitoring of groundwater, sediments, and biota, and five-year reviews as Alternative CSBL-2.

Effectiveness. Alternative CSBL-3 would provide protection of human health and the environment by implementing institutional controls, and by removing drums and contaminated sediments from Cold Spring Brook Pond, thereby reducing the potential for human and ecological exposure to site-related contamination. The installation of a low-permeability cover would limit infiltration and reduce the potential for contaminant leaching thereby reducing contaminant mobility. No reduction in the toxicity or volume of landfill wastes would be achieved. Because landfilled materials would not be removed, potential future releases to groundwater and Cold Spring Brook Pond sediment could occur and the potential would exist for future remedial action. Low-permeability caps are proven technologies whose reliability is dependent on proper installation and long-term maintenance. The cap would improve runoff from the Cold Spring Brook Landfill

and reduce infiltration into waste material; however, a portion of landfill materials would remain in contact with the groundwater. Cap installation would destroy the established ecological community on the existing landfill surface. Drum and sediment removal activities would adversely affect benthic organisms in the removal area and could potentially adversely affect benthic and other aquatic organisms in the pond and associated wetland. Actual and potential adverse effects on affected wetlands would be mitigated through an approved wetland restoration program. A new ecological community would establish itself on the new cover. The environmental monitoring program and five-year reviews are required to confirm that this alternative would continue to protect public health and the environment. By landfill capping, hot spot removal of contaminated sediments, and long-term monitoring, this alternative would meet remedial action objectives.

Implementability. Zoning and deed restrictions would be relatively easy to implement on Army property. Landfill capping, sediment removal, and drum removal are well-developed technologies. For sediment removal and cap construction, access may be difficult because of the steep landfill slope and wet conditions along the toe of the slope. A large number of trees would have to be removed to prepare the site for capping. Cap construction and sediment removal activities would affect wetlands and habitat in the vicinity of Cold Spring Brook Landfill and would trigger several action-specific ARARs. Prior to implementing this alternative, the remedial contractor would need to inform federal and Commonwealth regulators of details concerning planned remedial activities, including wetland restoration activities, and consider regulatory comments during finalization of plans. The potential adverse effects on wetlands and habitat will be a significant concern in the detailed evaluation of this alternative. The remedial contractor would not be required to obtain licenses and permits for on-site activities.

Implementation of this alternative would not prevent the undertaking of additional remedial actions. However, any future actions would need to be implemented to prevent penetration of the cover system or would need to repair any penetrations that occurred. Future implementation of Alternative CSBL-4, Landfill Excavation, would result in excavation of the cover. Although some soil materials and riprap could potentially be recovered for reuse, most of the cost of installing the cover would be lost.

Cost. Alternative CSBL-3 includes the costs of Alternative CSBL-2 plus the additional cost of installing the low permeability cover system and increased wetland restoration cost. This is expected to substantially increase capital costs in comparison to Alternative CSBL-2. O&M costs would be similar to those for Alternative CSBL-2 with some additional cover maintenance costs.

Conclusion. Alternative CSBL-3 will be retained for further evaluation in the detailed analysis because it meets remedial action objectives (see Table 4-2). Construction of a landfill cap and sediment removal could have a substantial impact on established wetland, pond, and landfill surface ecological communities and would be more expensive than Alternative CSBL-2. This will be a consideration in the detailed analysis and the comparative analysis of alternatives.

4.2.3 Alternative CSBL-4: Landfill Excavation/Drum and Hot Spot Sediment Removal

Description. Alternative CSBL-4 is a source removal option that includes excavation and removal of Cold Spring Brook Landfill materials including drums, hot spot removal of contaminated sediments from Cold Spring Brook Pond, and short-term environmental monitoring. For purposes of this evaluation, it was assumed that excavated materials would be consolidated at Fort Devens in a properly engineered facility. A short-term environmental monitoring program will be implemented for this alternative.

Effectiveness. This alternative would provide protection of human health and the environment by removing contaminated sediments from Cold Spring Brook Pond, and removing drums and landfilled material from the Cold Spring Brook Landfill and disposing of them at approved facilities. Excavated debris would be consolidated at a suitable Fort Devens location. If landfill debris is suitable, it may be possible to recover it for beneficial uses according to 310 CMR 19.062. This would have the potential to reduce costs while maintaining alternative effectiveness. This would be evaluated further during the design of this alternative. No reduction of toxicity or volume through treatment would be achieved. Landfilled materials would be excavated from above and below the water table, eliminating the potential for future release of contamination to the groundwater and pond sediment and reducing contaminant mobility. Sediment removal activities and landfill excavation would cause adverse short-term ecological effects to excavated areas and potentially to the pond and surrounding

wetland. A wetland restoration program would be implemented to mitigate these effects and enable recovery of plant and animal species in the area. In addition, waste material excavation would potentially cause nuisance dust and odor problems.

Implementability. Landfill excavation, sediment removal and drum removal, are well-developed technologies that would be easily implemented. For sediment removal and landfill excavation, access may be difficult because of wet conditions along the toe of the landfill slope. A large number of trees would need to be removed to prepare the site for remedial activities. To implement this alternative, a suitable location to consolidate 100,000 cy of demolition debris would have to be located. Landfill excavation and sediment removal activities would affect wetlands and habitat in the vicinity of Cold Spring Brook Landfill and would trigger several action-specific ARARs. Prior to implementing this alternative, the remedial contractor would need to inform federal and Commonwealth regulators of details concerning planned remedial activities including wetland restoration activities, and consider regulatory comments during finalization of plans. The remedial contractor would not be required to obtain licenses and permits for on-site activities. The potential adverse effects on wetlands and habitat will be a significant concern in the detailed evaluation of this alternative. Consolidation of debris at an existing Fort Devens location would not require obtaining permits pursuant to 310 CMR 16.00.

The reliability of this alternative is largely dependent on the reliability of the consolidation facility at preventing contaminant releases and receptor exposure. With proper construction and maintenance, the consolidation facility should provide reliable contaminant control. Implementation of this alternative would not affect the ease of undertaking additional remedial actions at Cold Spring Brook Landfill.

Cost. Estimated capital costs for Alternative CSBL-4 include the cost components of Alternative CSBL-2 plus the capital cost of excavating and consolidating landfill debris and of performing additional wetland restoration. This is expected to make this substantially more expensive than Alternative CSBL-3 and the most expensive of the four evaluated alternatives. O&M costs would be primarily associated with long-term groundwater and environmental monitoring.

Conclusion. Alternative CSBL-4 is a high cost source removal option that meets remedial action objectives. It will be retained for further evaluation in the detailed analysis (see Table 4-3). Excavation activities at the landfill will have a substantial impact on established pond and landfill surface ecological communities. This will be a consideration in the detailed analysis and comparative analysis of alternatives.

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR COLD SPRING BROOK LANDFILL OPERABLE UNIT

The detailed analysis of alternatives provides a detailed description of each of the Cold Spring Brook Landfill Operable Unit remedial alternatives and evaluates them using the evaluation criteria recommended in USEPA's RI/FS guidance (USEPA, 1988b). These criteria are described in Table 5-1. The first seven of the evaluation criteria serve as a basis for conducting the detailed analysis, and are addressed in this FS. The remaining two criteria, state and community acceptance will be addressed after the public comment period on the Proposed Plan. The alternatives that are evaluated in this section are those retained after initial screening in Section 4.0 and listed in Table 4-4. A detailed cost estimate is also included in the detailed analysis for each alternative. The cost estimate includes a present worth analysis to evaluate expenditures that occur over different time periods. This analysis discounts all future costs to a present worth and allows the cost of remedial alternatives to be compared on an equal basis. Present worth represents the amount of money that, if invested now and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life (USEPA, 1988b). A discount rate of 7 percent before taxes and after inflation was used as recommended in OWSER Directive 9355.3-20. Unless noted otherwise, costs are based on a 30-year time frame.

Four alternatives are evaluated in the detailed analysis:

- No Action
- Drum Removal Hot Spot Sediment Removal
- Landfill Capping/Drum and Hot Spot Sediment Removal
- Landfill Excavation/Drum and Hot Spot Sediment Removal

The No Action Alternative was retained as a baseline with which to compare other alternatives. Alternative CSBL-2 was retained because it provides institutional controls, drum removal, and hot spot sediment removal to reduce human health and ecological risks. The remaining two alternatives at the Cold Spring Brook Landfill include the same protective measures included in the Alternative CSBL-2, as well as remedial actions for the landfill itself to reduce the potential for future releases to groundwater or Cold Spring Brook Pond sediment.

5.1 ALTERNATIVE CSBL-1: NO ACTION

This subsection describes the No Action Alternative, evaluates the alternative using the seven evaluation criteria and provides a cost estimate.

5.1.1 Description

The No Action Alternative serves as a baseline alternative with which to compare other remedial alternatives for the Cold Spring Brook Landfill Operable Unit. No action will be taken as part of this alternative to prevent future residential exposure to groundwater exceeding PRGs or to reduce ecological risk from exposure to sediments in Cold Spring Brook Pond. To monitor potential migration of contamination toward Patton Well, this alternative proposes installation of two new monitoring wells, and long-term groundwater monitoring at Cold Spring Brook Landfill. The following specific actions are included in the No Action Alternative:

- Site Preparation and Mobilization
- Monitoring Well Installation
- Groundwater Monitoring
- Five-year Site Reviews

Each of these components is described in the following paragraphs.

<u>Site Preparation</u>. The only site preparation that would be required would be the mobilization of a drill rig for installation of additional groundwater monitoring wells.

<u>Monitoring Well Installation</u>. At present, monitoring well CSB-2 is interpreted as the only directly downgradient well between Cold Spring Brook Landfill and Patton Well. It is screened, however, approximately 14 to 34 feet below the water table. Wells CSB-92-02A, a water table well, and CSB-92-02B, a deep overburden well, may be slightly cross-gradient. Monitoring wells CSB-2, CSM-93-01A, and CSM-93-02B are screened at elevations that overlap or approximate the screened interval at Patton Well, and therefore are suitably positioned to monitor the movement of contaminants toward Patton Well below the water table. To provide additional characterization of downgradient groundwater and protection of Patton Well, this alternative proposes installation of two new water table

monitoring wells in the vicinity of well CSB-2. These wells would monitor potential contamination moving along the water table, a likely migration pathway, toward Patton Well. Four-inch diameter polyvinyl chloride (PVC) monitoring wells approximately 30-feet deep are proposed. The approximate location of these wells is shown on Figure 4-1.

Groundwater Monitoring. Groundwater monitoring is proposed to confirm that groundwater quality will remain acceptable over time and to detect any contaminants downgradient of the landfill which may be moving toward Patton Well. Five existing monitoring wells, CSB-1, CSB-2, CSB-3, CSM-93-2A, and CSM-93-02B, plus the two newly installed downgradient monitoring wells would be sampled and analyzed semi-annually consistent with the monitoring requirements of 310 CMR 19.132 for a minimum of 30 years. Monitoring locations and analytical parameters are presented in Table 5-2. Assumptions made for this monitoring plan are for cost estimating purposes only. Final detailed monitoring plans would be developed in conjunction with regulatory agency review and comment.

Landfill gas monitoring is not proposed at Cold Spring Brook Landfill. The construction debris at the landfill is not expected to generate landfill gas, and ambient air monitoring during the RI did not identify VOCs above background at the landfill.

Five-year Site Reviews. Under CERCLA 121c, any remedial action (or lack thereof) that results in contaminants remaining on-site must be reviewed at least every five years. Data collected during the groundwater monitoring program would provide information for these reviews. The reviews would evaluate whether Alternative CSBL-1 is protective of human health and the environment and whether additional remedial actions should be initiated.

5.1.2 Remedial Alternative Evaluation

The assessment of this alternative using the evaluation criteria is presented in the following subsections.

5.1.2.1 Overall Protection of Human Health and the Environment. The No Action Alternative will be protective of human health under current land use conditions. There is no residential exposure to contaminated groundwater under

current conditions and consequently, the baseline risk assessment did not identify human health risks above USEPA criteria. The No Action Alternative will not control the potential future installation of residential wells at/or adjacent to the landfill and potential residential exposure to COPCs presenting risks above USEPA criteria. The installation of additional monitoring wells and implementation of a long-term groundwater monitoring program will enable detection of potential future migration of contaminants from the landfill toward Patton Well.

The No Action Alternative will not reduce potential risks to ecological receptors from exposure to contaminated sediments in Cold Spring Brook Pond.

5.1.2.2 Compliance with ARARs. Table 5-3 provides a summary of the ARARs analysis for Alternative CSBL-1. Chemical-specific ARARs will be met for all analyzed COPCs except bis(2-ethylhexyl)phthalate and manganese. Bis(2-ethylhexyl)phthalate exceeded the relevant and appropriate Phase V MCL (6 μg/L) once at 14 μg/L at well CSM-93-02B. Manganese exceeded the SMCL and the Massachusetts Groundwater Quality Criterion of 50 μg/L at several monitoring wells around the landfill, ranging from 69.9 to 6,120 μg/L. The calculated background concentration is 291 μg/L in groundwater at Fort Devens. Actions proposed in this alternative include installation and monitoring of groundwater monitoring wells. These actions would not trigger any location-specific or action-specific ARARs.

5.1.2.3 Long-Term Effectiveness and Permanence. Although the No Action Alternative provides an effective means to monitor potential future migration of contaminants from Cold Spring Brook Landfill toward Patton Well, it does nothing to control future residential exposure to groundwater at/or adjacent to the landfill.

This alternative does not provide controls to reduce contaminant levels in sediment in the Cold Spring Brook Pond, or to remove drums as a potential source of groundwater or sediment contamination.

5.1.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment. The No Action Alternative does not employ removal or treatment processes to address sediment contamination. Therefore, there would be no reduction of toxicity, mobility, or volume of contaminants in sediment.

5.1.2.5 Short-Term Effectiveness. This alternative does not provide any remedial actions at the landfill. Therefore, there would be no short-term risks to the community as a result of implementation. The only potential risk to workers could be during installation and sampling of groundwater monitoring wells. Personnel who conduct drilling and long-term groundwater monitoring would follow a site-specific Health and Safety Plan (HASP), and utilize personnel monitoring and personal protective equipment to prevent potential exposure to hazardous chemicals. However, based on available groundwater monitoring data, chemical hazards are not anticipated.

5.1.2.6 Implementability. Services, materials and contractors are readily available to install new groundwater monitoring wells. The proposed long-term groundwater monitoring program would adequately monitor any potential future releases from the landfill.

The No Action Alternative would not limit or interfere with the ability to perform future remedial actions.

5.1.2.7 Cost. A cost estimate was prepared for Alternative CSBL-1 to assist in selecting a remedial alternative. As discussed previously, the estimate consists of direct and indirect capital costs, and O&M costs.

Direct capital costs for the No Action alternative include the cost to mobilize a drill rig and install new groundwater monitoring wells. O&M costs would include maintenance of these wells, long-term groundwater monitoring, and five-year site reviews. Table 5-4 summarizes the cost estimate for Alternative CSBL-1. Total direct and indirect cost is estimated to be $13,000. The present worth of O&M costs ranges is estimated to be $372,000. The estimated total present worth of Alternative CSBL-1 is $385,000. Cost calculations are contained in Appendix A.

5.2 ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

This subsection describes Alternative CSBL-2, evaluates the alternative using the seven evaluation criteria, and provides a cost estimate.

5.2.1 Description

Alternative CSBL-2 for the Cold Spring Brook Landfill is designed to reduce potential future human health risks and current and future ecological risks. In addition to the long-term groundwater monitoring program of Alternative CSBL-1, this alternative provides institutional controls to reduce potential future residential exposure to potentially contaminated groundwater, removes exposed drums at the landfill, implements landfill bank and surface improvements, and excavates sediment from Cold Spring Brook Pond hot spots which contribute the greatest amount to ecological risks. The following specific actions are included in Alternative CSBL-2:

- Site Preparation and Mobilization
- Drum Removal and Disposal
- Sediment Removal and Disposal
- Bank and Surface Improvements
- Wetland Restoration
- Institutional Controls
- Environmental Monitoring
- Five-year Site Reviews (Subsection 5.1.1)

Site Preparation and Mobilization. To enable equipment access to the areas of proposed drum and sediment removal, some clearing of trees on the surface of Cold Spring Brook Landfill, and possibly the construction of temporary access roads, would be required. Drum removal will be attempted by hydraulic excavator or backhoe from the landfill surface. Some tree removal and minor regrading of the landfill surface may be needed to accomplish this task. Sediment removal from sediment Area I would also be attempted from the landfill surface. The most direct access to sediment Area I from Patton Road is to cross the landfill east of well CSM-93-01A (see Figures 4-2 and 1-4). However, the landfill surface is relatively high in this area and it may not be possible to reach the entire sediment removal area. As an alternative, approaching the sediment removal area via a more easterly route may make sense. The pond bank is lower and the debris/rubble would provide a relatively firm foundation for excavation equipment. Even with this approach, construction of up to 200 feet of temporary road along the edge of the pond/landfill may be necessary. A third alternative would be to construct approximately 500 feet of temporary access road along the northwestern side of the landfill. Construction of either access road would likely

require placement of a geotextile mat and significant quantities of gravel over the naturally occurring peat to support heavy equipment. Construction of the longer road would also require removal of a number of trees. As indicated in Figure 1-4, it may be possible to construct the road along the northwest edge of the landfill without crossing wetland areas. However, this would need to be confirmed. The cost estimates for sediment removal at Area I are based on construction and subsequent removal of 200 feet of temporary access road.

Prior to excavation at sediment Area II near the outlet of Cold Spring Brook Pond, some fill material may need to be placed along the bank of the pond to provide a level platform for equipment. Access would be from Patton Road east of the pond. For cost estimating purposes, it is assumed that gravel can be obtained on-site from the southern side of Patton Road to construct the work platforms and access roads. If this gravel cannot be used, material costs would increase. These access roads would be temporary, and would be removed following completion of remedial activities at the landfill. The cost estimates include the cost to remove any temporary roads or work platforms at Area II.

Construction of a lined dewatering basin for sediment, a lined drum storage area for staging drums, small decontamination pads and a small parking area would be required.

Equipment requiring mobilization includes a clamshell crane, watertight dump trucks, backhoes, excavators, water storage tanks, and a drill rig.

Sediment Removal and Disposal. Sediment removal is proposed for two hot spot locations in the pond. The first hot spot location (Area I) is a small inlet east of monitoring well CSB-5 bounded by sediment sampling locations CSD-92-07X, CSD-92-08X, and CSD-92-09X. The second location (Area II) is at the pond outlet. For the cost estimating purposes of this FS, the volume of sediment to be removed has been estimated to be 1,200 cy.

A silt fence or a floating boom weighted at bottom would be placed around the two excavation areas to prevent sediment suspended during excavation from migrating to other locations in the pond. Sediment removal would be attempted by a long-stick hydraulic excavator or a crane with a watertight clamshell bucket to minimize the quantity of water and sediment spilling adjacent to the excavation. As described above, if access from on top of the landfill is not

successful, a temporary access road would be constructed along the northern side of the landfill, and sediment would be removed with an excavator. Sediment would be placed in watertight dumptrucks and transported to a lined dewatering basin constructed as close to the "landfill" area as practicable. One possible location is the flat area south of Patton Road, shown on Figure 4-2. For cost estimating purposes, the lined dewatering basin is proposed to be 50 ft. by 200 ft. with a 4 ft. depth, constructed with an impervious liner to temporarily store sediment and water.

As the sediment settles out, the supernatant water will be pumped into frac tanks and sampled. If analysis shows that the water will not cause Cold Spring Brook Pond to exceed AWQC, it will be discharged back to the pond. If water quality does not meet acceptable criteria it will be treated on-site in a mobile clarifier before discharge to the pond. Sediment samples will be collected and TCLP analysis conducted. Based on the results of the TCLP analysis, sediments will be disposed at a solid waste landfill or a RCRA TSD facility. The addition of a sorbent or solidifying agent may be necessary to eliminate free water prior to transport and disposal.

Previous sediment samples have passed the TCLP analysis, therefore, for purposes of cost estimating, it is assumed that sediment will be disposed of at a solid waste landfill. The cost estimate includes the cost of a mobile clarifier to polish supernatant water. The cost estimate for sediment removal is contained in Appendix A. Assumptions and quantity calculations for sediment removal are provided in Appendix B.

Drum Removal. As part of Alternative CSBL-2, fourteen 55-gallon drums along the northern edge of Cold Spring Brook Landfill would be removed and disposed of properly. Some drums are located on the landfill bank and some are partially submerged in the pond. Drum removal would be attempted with a backhoe or hydraulic excavator working from cleared areas on top of the landfill.

Drums with contents would be lifted manually or by means of a sling, and overpacked into 85-gallon drums. These drums would then be removed and staged on a lined, bermed, on-site staging area approximately 400-square feet in size. Drum contents would be sampled and analyzed for TCLP constituents following drum staging. After TCLP results are obtained, the drums would be disposed at an off-site solid waste landfill or an off-site RCRA TSD facility.

Empty drums would be placed in polybags and removed from the site. Empty drums would be taken to a metal reclaiming facility or a RCRA TSD facility. Assumptions for estimating drum removal costs are provided in Appendix C.

Bank and Surface Improvements. To reduce potential physical hazards associated with protruding debris and surface depressions, this alternative includes a bank and surface improvement program. This program would involve removing or covering protruding debris (e.g., rebar, pipe, and concrete slabs) and filling surface depressions that could pose potential physical hazards. Some regrading of the landfill surface could be required; however, complete regrading/covering is not anticipated. Disturbed areas would be graded and seeded to prevent erosion.

Wetlands Restoration. Sections of Cold Spring Brook Pond and the bordering wetland areas altered during remedial activities will be restored in accordance with a WRS prepared prior to any wetland restoration. These altered areas are expected to include areas of sediment removal and temporary access road construction. The WRS would incorporate guidelines from the Massachusetts Wetland Protection Act and Regulations, specifically 310 CMR 10.55. The primary goal of wetland restoration activities at Cold Spring Brook Pond and the surrounding wetland area would be to restore self-sustaining freshwater wetlands in situ (i.e., in the same "footprint" as the altered wetlands). The surface area of the restored wetland would be equal to or greater than that of the altered wetland.

Restoration of wetlands at Cold Spring Brook Pond would:

- reduce the long-term impacts of activities in and adjacent to the wetlands;
- compensate for losses of wetland habitats;
- restore or replace degraded wetlands; and
- meet state and federal permitting and regulatory guidelines and requirements.

Depending on federal and state regulatory guidance, as well as financial and temporal considerations, a number of diverse approaches exist to restore self-

sustaining wetlands. At a minimum, wetland restoration would include backfilling with suitable material to achieve desired grade and controlling erosion and siltation. At the other extreme, wetland restoration could involve the above activities, plus transplanting or purchasing nursery stock to partially or fully revegetate the altered wetland.

At Cold Spring Brook Pond and the surrounding wetland area, it is anticipated that required wetland restoration would be relatively minor. The areas of sediment excavation within the pond would require backfilling to pre-remediation grade. Restoration in the wetland area on the northwest side of Cold Spring Brook Landfill where an access road may be placed would require removal of road materials, backfilling and grading to match the pre-remediation grade, and potentially revegetating the disturbed area.

Based on regulatory guidelines including 310 CMR 10.55 and wetlands regulations regarding restoration, the WRS should include: careful consideration of Cold Spring Brook Pond hydrology, topography, vegetation, and soil characteristics; evaluation of wetlands functional assessment; examination of regional wetlands replacement literature; consultation with regulatory and technical authorities; and experience with similar wetland restoration projects. This WRS would be prepared in accordance with state and federal technical requirements for wetland alteration. Development of the WRS may depend on terms described in the IAG between the U.S. Army and the USEPA (USEPA, 1991). The WRS would include a detailed description of all proposed activities, a discussion of goals based on wetland functional attributes, and a long-term monitoring plan (which would be combined with the proposed biomonitoring).

The goal of wetlands restoration would be to restore the wetland within the same footprint to achieve at a minimum, the same values and functions as determined by the evaluation used to assess the functions and values of the Cold Spring Brook wetland. Appendix G contains a Wetlands Functional Assessment report (updated from the RI Addendum Report) that characterizes the habitat at Cold Spring Brook Pond.

It is difficult to estimate the costs of implementing the WRS until it has been developed and approved, and state and federal regulatory requirements are better defined. For cost-estimating purposes of this FS, a cost of $50,000 per acre was assumed for wetland restoration activities, including soil replacement,

revegetation, monitoring, and maintenance. It is estimated that the sediment excavation areas and temporary access road areas to be restored would include approximately 0.5 acres.

Institutional Controls. Institutional controls are proposed in the form of zoning and deed restrictions for any property released by the U.S. Army during Fort Devens base closure activities. The Fort Devens Preliminary Reuse Plan, Main and North Posts (EDAW and VHB, 1994) has proposed that U.S. Army land north of Patton Road, including Cold Spring Brook Landfill and Cold Spring Brook Pond, would be zoned as open space.

By preempting residential use, these controls will help limit human exposure. In addition, the U.S. Army will place deed restrictions on landfill area property to prohibit installation of drinking water wells. This, in combination with long-term groundwater monitoring, would protect potential human receptors from potential future releases to groundwater. These controls would be drafted, implemented and enforced in cooperation with state and local government.

Institutional controls would also include periodic public meetings and presentations to increase public awareness. This would help keep the public informed of site status, including both its general condition and remaining contaminant levels. This could be accomplished by conducting public meetings every five years coincident with the five-year site reviews for the Cold Spring Brook Landfill. The presentation would summarize site activities and the results of environmental monitoring programs.

Long-Term Environmental Monitoring. As stated previously, Cold Spring Brook Landfill has not been shown to be a source of groundwater contamination; however, to monitor potential future releases to groundwater or sediment, the effectiveness of hot spot sediment removal activities, and the progress of wetlands restoration, a long-term environmental monitoring program is proposed. Monitoring would involve periodic sampling of groundwater, wetland sediments, microorganisms, and visual observations of wetland restoration areas. The monitoring plans described below are for cost-estimating purposes only. Final, detailed monitoring plans would be developed in conjunction with regulatory agency review and comment.

Groundwater monitoring is proposed to confirm that groundwater quality will remain acceptable over time. The groundwater monitoring program proposed for Alternative CSBL-2 is the same as that proposed for the No Action Alternative (see Subsection 5.1.1). Groundwater monitoring locations and analytical parameters are presented in Table 5-2.

The existing landfill cover does not include landfill gas vents or a gas venting layer, therefore landfill gas monitoring is not proposed as part of Alternative CSBL-2. Ambient air monitoring during the RI did not detect VOCs at concentrations above background.

Sediment sampling is proposed to determine if there is an ongoing source of sediment contamination. Two surface sediment samples would be collected in each hot spot excavation area (Areas I and II) for a total of four samples. Sediment samples would be collected once every five years and analyzed for parameters listed in Table 5-5. Sampling is proposed for 30 years because the Cold Spring Brook Landfill will remain a potential source of contamination. Future sediment data would be compared to data collected during the RI field efforts. Sediment data would be presented in the five-year site reviews.

A biomonitoring program developed with input from federal and state regulators is recommended at Cold Spring Brook Pond. Site-specific objectives of the biomonitoring program would include the following:

- to evaluate if macroinvertebrate population or community level effects are evident adjacent to the landfill; and
- to monitor ongoing macroinvertebrate trend conditions at a reference station to identify regional effects that may be occurring.

Fish tissue sampling is not proposed, because initial studies did not identify impacts to fish living in Cold Spring Brook Pond (see RI Addendum Report, ABB-ES, 1993b). Macroinvertebrate sampling was conducted in the fall of 1992 during the supplemental RI field effort. Future macroinvertebrate monitoring is proposed biennially for the first five years. Future macroinvertebrate data would be compared to the data collected for the RI Addendum Report and presented as a part of the first five-year site review. The need for future biomonitoring would be evaluated at that time.

Monitoring of the wetland restoration area would be essential to determine the success of the restoration. Monitoring requirements would be defined in the WRS and would include an evaluation of restored wetland functions and values. For cost-estimating purposes, it was assumed that restoration monitoring would include a one-day site inspection conducted semi-annually for five years. Results of wetland restoration monitoring would be presented in the first five-year site review, and the need for future wetlands restoration monitoring would be evaluated at that time.

5.2.2 Remedial Alternative Evaluation

The assessment of this alternative using the evaluation criteria is presented in the following subsections.

5.2.2.1 Overall Protection of Human Health and the Environment. Alternative CSBL-2 has a significant potential for protecting human health and the environment under both current and future land use conditions. As stated previously, human health risk assessment indicates that there are no current risks associated with residential use of groundwater at Cold Spring Brook Landfill.

Alternative CSBL-2 relies on institutional controls in the form of zoning and deed restrictions to control potential future residential exposure to groundwater at Cold Spring Brook Landfill.

As with Alternative CSBL-1, Alternative CSBL-2 would provide protection of the Patton Well by installing two additional monitoring wells downgradient of the landfill and providing long-term monitoring of these and other Cold Spring Brook Landfill monitoring wells. In addition, educational programs conducted to keep the public informed of the site's status would contribute to the overall protection of human health.

Alternative CSBL-2 would protect the environment by removing sediment from hot spot areas that pose an ecological risk, and removing drums which may be a potential source of future release to the environment.

5.2.2.2 Compliance with ARARs. Table 5-6 provides a summary of the ARARs analysis for Alternative CSBL-2. As for Alternative CSBL-1, chemical-specific

ARARs are being met for all analyzed COPCs except bis(2-ethylhexyl)phthalate and manganese for Alternative CSBL-2.

Location-specific ARARs regarding wetlands protection will be triggered by sediment and possibly drum removal activities. Sediment dredging and drum removal activities would be conducted to minimize adverse impact on wetland areas according to the Protection of Wetlands Executive Order No. 11990 (40 CFR Part 6), and activities would be coordinated with the U.S. Fish and Wildlife Service in accordance with the Fish and Wildlife Coordination Act (16 USC 661 et seq.). Proposed wetland restoration activities would help to meet location-specific ARARs.

Several action-specific ARARs apply to this alternative. Sediment dredging in Cold Spring Brook Pond would be conducted in accordance with the Massachusetts regulations at 314 CMR 9.00 for water quality certification and certification for dredging. Some excavated sediments and drum contents may exhibit hazardous characteristics, and would therefore require disposal in accordance with RCRA regulations 40 CFR 268, CERCLA 121 (d)(3), and Massachusetts Hazardous Waste Regulations 310 CMR 30.000.

5.2.2.3 Long-Term Effectiveness and Permanence. Alternative CSBL-2 does not provide controls to prevent potential future releases from the landfill to groundwater; however, the landfill has not been shown to be a historical release source, so implementation of source "controls" may not be warranted. The long-term effectiveness of this alternative at protecting potential future human exposure is dependent on enforcement of institutional controls and the long-term groundwater monitoring program. These actions have potential long-term effectiveness at Cold Spring Brook Landfill for several unique reasons. First, the U.S. Army currently owns all the property of concern. Thus, land use can be controlled directly as long as the U.S. Army retains property ownership. In the event of a property transfer, as envisioned as part of base closure, the U.S. Army can implement zoning and deed restrictions to pre-empt residential use. Second, groundwater is interpreted to discharge to Cold Spring Brook Pond from both the north and south. Thus, contaminants cannot migrate in groundwater to the north or south away from the landfill. This makes it unlikely that a residential well located anywhere except within the landfill boundary or immediately adjacent to it would receive contamination from the landfill. This increases the potential for institutional controls to be effective. Finally, at the western end of the landfill

where Patton Well is interpreted to influence groundwater flow patterns, no off-site migration of groundwater contaminants has been observed. Therefore, the proposed groundwater monitoring program has potential effectiveness to monitor the potential migration of contaminants toward Patton Well.

Alternative CSBL-2 provides long-term effectiveness and permanence in reducing ecological risk by excavation and removal of hot spot sediments and drums from Cold Spring Brook Pond and the landfill area. Contaminated sediments and drum contents will be disposed off-site, thereby eliminating any current risk to aquatic and semiaquatic receptors. Long-term sediment and biomonitoring programs would adequately monitor any future potential releases to the pond.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment. No treatment technologies are proposed for Alternative CSBL-2. No reduction of toxicity, mobility, or volume of existing or potential contaminants in groundwater would be achieved with this alternative. Sediment and drum removal would not reduce the toxicity or volume of contaminants in sediments and drum contents. However, dewatering and stabilization/solidification of excavated sediment would reduce contaminant mobility and concentrate contaminants into a manageable matrix for off-site transportation and disposal.

5.2.2.5 Short-term Effectiveness. Minimal short-term risks to the community would be expected during implementation of this alternative. There are no residences close enough to the site to be affected by noise or dust potentially generated from sediment or drum removal. Excavation of hot spot sediments could result in the transportation and off-site disposal of 1,200 cy of sediment. Several potential routes exist for transporting materials off site at Fort Devens, and it is anticipated that transportation can be planned to avoid traffic congestion and hazards. In addition, rerouting of traffic on the section of Patton Road south of the Cold Spring Brook Landfill would be evaluated. Inclusion of this section of the road and an area to the south of Patton Road in the exclusion zone used during sediment excavation and dewatering would facilitate remedial activities. Adherence to RCRA and U.S. Department of Transportation (DOT) regulations affecting handling/transportation of any potentially characteristic hazardous soils/sediments would reduce the risk of community exposure to an uncontrolled release of hazardous materials to a safe level. This alternative could present some potential risk to site workers and the environment during excavation and handling of sediment and drums, and long-term groundwater monitoring.

However, with the use of dust suppression techniques and adherence to general health and safety practices during excavation and handling of sediment and drums, potential exposure to contaminated soils, sediments, and liquids would be reduced to a safe level. In addition, personnel who conduct drilling and long-term groundwater monitoring would need to follow a site-specific HASP, and utilize personnel monitoring and personal protective equipment to prevent potential exposure to hazardous chemicals. However, based on available groundwater monitoring data, chemical hazards are not anticipated.

The excavation of sediment hot spots would destroy benthic and aquatic habitat within the excavation area. In addition, the construction of an access road along the northwest edge of the landfill might cross wetland areas and adversely affect wetland habitat.

No endangered species or species of special concern are known to occur at Cold Spring Brook Pond. However, silt fence or a floating boom weighted at the bottom and placed around the areas of sediment excavation would minimize sediment contaminant migration beyond the excavation boundaries. Wetland restoration in disturbed areas would mitigate short-term impact and minimize long-term impact to the environment. Because the disturbed areas would be relatively small compared to Cold Spring Brook Pond and bordering wetland, adverse community effects, although possible, are unlikely.

5.2.2.6 Implementability. Placement of zoning and deed restrictions on property currently owned by the U.S. Army would be easily implemented in the event of property transfer. Equipment required to excavate and handle sediment, remove and handle 55-gallon drums and potentially construct an access road at the Cold Spring Brook Landfill is conventional in nature, and contractors are readily available. Implementation of this alternative would not limit or interfere with the ability to perform future remedial actions.

Off-site disposal services would be required for excavated sediments and drums. Sediment would require dewatering to eliminate free water prior to disposal. An estimated 2,850 tons of sediment, drying agent, and temporary roadway as well as four overpacked drums would require off-site disposal. Some sediments and drummed contents may exhibit hazardous characteristics, and would require disposal at a licensed landfill or incinerator. Off-site services should have sufficient capacity for this volume of materials.

According to the NCP, no federal, state, or local permits are required for on-site response actions conducted pursuant to CERCLA, although coordination with review agencies is recommended. Because remedial actions for the Alternative CSBL-2 will be conducted on-site, permits would not be required for sediment dredging or discharge of water from dewatered sediment to Cold Spring Brook Pond. However, consultation with the local conservation commission in accordance with Massachusetts Wetlands Protection Regulations (310 CMR 10.000) may be required prior to constructing an access road at the northwestern toe of the landfill. In addition, dredging of sediment in Cold Spring Brook Pond will have to be done in accordance with the technical requirements of the Massachusetts Waterways Act (MGL, c. 91; 310 CMR 9.00), and the Massachusetts Water Quality Certification for Dredging (314 CMR 9.00). Enforcement of zoning and deed restrictions would require cooperation with the Town of Harvard.

5.2.2.7 Cost. In addition to cost items listed for the No Action Alternative, direct capital costs for Alternative CSBL-2 include institutional controls; site preparation and mobilization; access road construction and sediment and drum removal; construction of a sediment dewatering basin; transportation and disposal of drums, sediment, and water; wetland restoration; and demobilization.

Additional O&M costs include educational programs, sediment and biomonitoring, and wetlands restoration monitoring. Table 5-7 summarizes the cost estimate for Alternative CSBL-2. The total direct and indirect cost is estimated to be $1,518,000. The present worth of O&M costs is estimated to be $462,000. The estimated total present worth of Alternative CSBL-2 is $1,980,000. Cost calculations are contained in Appendix A.

5.3 ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL

This subsection describes the Landfill Capping/Drum and Hot Spot Sediment Removal Alternative, evaluates the alternative using the seven evaluation criteria, and provides a cost estimate.

5.3.1 Description

The Landfill Capping/Drum and Hot Spot Sediment Removal Alternative is designed to reduce potential future human health and current and future ecological risks by providing a low-permeability cover system in addition to the remedial actions described for Alternative CSBL-2. Installing a low-permeability cover system over the Cold Spring Brook Landfill will reduce infiltration of precipitation to the debris and minimize potential future releases from the landfill to groundwater or Cold Spring Brook Pond sediment. The major components of the Landfill Capping/Drum and Hot Spot Sediment Removal Alternative are:

- Site Preparation and Mobilization
- Cover System Design and Placement
- Drum Removal and Disposal (see Subsection 5.2.1)
- Sediment Removal and Disposal (see Subsection 5.2.1)
- Wetland Restoration
- Cover System Monitoring and Maintenance
- Institutional Controls (see Subsection 5.2.1)
- Environmental Monitoring (see Subsection 5.2.1)
- Five-year Site Reviews (see Subsection 5.1.1)

Each of the components not described in previous subsections is described in the following paragraphs.

Site Preparation and Mobilization. Site preparation and mobilization for Alternative CSBL-3 would include the site preparation activities and mobilization of equipment described in Subsection 5.2.1. Additional activities for the Landfill Capping/Drum and Hot Spot Sediment Removal alternative include partial dewatering of Cold Spring Brook Pond, potential construction of 500 feet of temporary access road along the northeastern edge of the Cold Spring Brook Landfill (Figure 5-1), and construction of a stockpile area approximately one acre in size for cover system materials. Additional equipment that would be mobilized to place the cover system include bulldozers, front-end loaders and dump trucks. The additional length of access road and partial dewatering the pond may be required to construct the toe of the slope of the cover system.

Cover System Design and Placement. To conform with the intent of Massachusetts regulations at 310 CMR 19.112: *Landfill Final Cover Systems*, a landfill cover must meet six general performance standards:

- minimize surface water infiltration to landfilled material
- promote surface water drainage
- minimize erosion
- facilitate venting and control of landfill gas
- isolate landfilled material from the environment
- accommodate settling and subsidence

The Massachusetts regulations also provide general design and component standards to achieve the performance standards. The conceptual cover system design proposed for Cold Spring Brook Landfill is intended to achieve the performance standards, but varies slightly from the general design standards in regard to final top slope, side slope and construction, and landfill gas venting.

Several factors combine to require a special approach to top slope and side slope design:

- the proximity of Patton Road (see Subsection 1.2)
- the shallow slope of the existing landfill surface (see Subsection 1.2)
- the interpreted northward flow of groundwater beneath the landfill and discharge to Cold Spring Brook Pond (see Subsection 1.3)
- the fact that landfilled rubble and debris extend into the pond along much of the landfill's northern boundary (see Subsection 1.2)

These factors create two special design constraints. The first constraint is the need to minimize the diversion of surface water from the landfill cover toward Patton Road, and the second is to not interrupt the continued discharge of groundwater to the pond. The closeness of the landfill to the road and the similarities in surface elevation make construction of drainage ditches, especially open, lined ditches, problematic. To minimize the southward diversion of surface water, it is proposed to hold cover system buildup to a minimum. It may also be necessary to incorporate surface slopes of less than 5 percent. The narrowness of

the landfill will help promote adequate lateral drainage at shallow slopes. Minimizing the buildup of the landfill surface in the middle of the landfill and reducing final top slope can be achieved by increasing side slope and thereby reducing the volume of waste pullback. (It is assumed that material pulled back from the sides would be placed on top of the landfill). Side slope design to prevent instability will be considered as part of the design to enable continued groundwater passage, the second special design constraint.

Maintenance of normal groundwater flow is an important design consideration for Alternative CSBL-3. Construction of low permeability cap on the north side of the landfill would block groundwater discharge to the pond and could have several adverse effects.

- The water balance of the pond would change. A reduced groundwater discharge to the pond could result in lower water levels, reduced water quality, and adverse ecological effects.
- Buildup of groundwater behind low permeability side slope cover would result in unbalanced hydrostatic heads and could contribute to side slope cover failure.
- Buildup of groundwater behind low permeability side slope cover has the potential to increase contact between debris and groundwater and the possibility of leaching.
- The effect of raising the water table in the vicinity of the landfill on groundwater quality at Patton Well is not known.

To maintain undisturbed groundwater discharge to Cold Spring Brook Pond, it is proposed to construct a riprap side slope on the north side of the landfill. A trench would be excavated through the layer of sediment at the bottom of the pond to the underlying sand layer to provide a stable footing for the riprap. A representative cross section through the proposed cover system showing a conceptual layout of the cover system north side slope is shown in Figure 5-2. It is proposed that the riprap slope extend as high as possible at a slope of 1.5 or 2 to 1 and that areas with 3 to 1 slope be held to a minimum. Use of riprap material should enable construction of a stable slope steeper than 3 to 1. During the cover system design, a natural filter should be designed to prevent siltation or

erosion below the groundwater table. In addition, the weight of the cover system layers and the groundwater uplift pressures should be compared to determine if the cover system needs to be thicker or if the geomembrane requires anchoring.

The proposed design does not include a gas venting layer because the construction debris in the Cold Spring Brook Landfill is not anticipated to generate landfill gas. Furthermore, the proposed placement of riprap on the north side of the landfill would allow landfill gas to escape and prevent gas accumulation, achieving the intent of 310 CMR 19.112.

To meet the desired performance standards, the proposed cover system would consist of the following components from bottom to top:

- subgrade fill
- hydraulic barrier layer
- drainage layer
- filter layer
- vegetative cover layer

Prior to placement of cover system layers, trees on the landfill surface would be cleared. In addition, grading of the landfill material and surface soil and addition of clean common borrow would be required to achieve cover design slopes. Massachusetts Regulations 310 CMR 19.112 specify a minimum top slope of five percent, and a maximum side slope of three horizontal to one vertical. However, as discussed previously, a more shallow top slope and a steeper side slope are proposed for at Cold Spring Brook Landfill. In addition to achieving required slopes, grading would cover or move any pieces of concrete or metal protruding from the surface of the landfill, and would sufficiently fill void spaces in the upper portion of the debris to create a stable base on which to place the cover system. Because of the makeup and age of the landfill debris, problems are not expected from future settling and subsidence. To grade the landfill surface effectively, some of the larger pieces of concrete and asphalt pavement may need to be broken up.

The majority of the cover system can be placed with equipment working from the graded landfill surface. However, to complete the cover system at the toe of the slope, a temporary access road may be required along the northeastern edge of the landfill, within the limits of Cold Spring Brook Pond (Figure 5-2). To

construct this access road, the pond may require partial dewatering, or, alternately, installation of coffer dams and groundwater pumping to enable access by construction equipment.

To promote stormwater runoff from the cover system, top slopes would be graded down to the north, east and west as much as feasible. Little stormwater run-on to the cover system is anticipated from Patton Road and areas south of the landfill because the soil in the vicinity is sandy. A shallow, unlined drainage swale could be constructed along the southern edge of the cover system to direct stormwater from Patton Road around the cover system to Cold Spring Brook Pond (see Figure 5-1). However, runoff from the cover would be expected to infiltrate rapidly, pre-empting the need for the drainage swale in the first place. Stormwater calculations would be conducted during design to determine the required extent of stormwater controls.

A very low density polyethylene (VLDPE) textured geomembrane is proposed for the hydraulic barrier of the landfill cover. The geomembrane would have a maximum in-place saturated hydraulic conductivity of $1x10^{-7}$ cm/sec and be placed above the subgrade fill. The subgrade fill would be placed above the landfill debris to cover the debris, fill voids, and provide a stable base for the cover system.

An 6-inch minimum thickness drainage layer with a minimum hydraulic conductivity of $1x10^{-3}$ cm/sec would be placed above the geomembrane to promote lateral drainage and minimize accumulation of water above the geomembrane. The drainage layer would direct intercepted infiltration to the perimeter of the cover and ultimately to Cold Spring Brook Pond.

A layer of geotextile and clean common borrow will be placed above the drainage layer to prevent the migration of topsoil fines from the vegetative layer to the drainage layer. The filter layer will also provide frost protection for the hydraulic barrier layer.

A 12-inch layer of soil capable of supporting grass growth would be placed above the filter layer. This soil should contain some fines to improve its capacity to hold water, and it would be seeded, fertilized and mulched to promote a stable vegetative cover.

A 18-inch filter layer has been used for the cost estimating purposes of this FS, resulting in a total soil thickness of 36 inches above the hydraulic barrier layer. This is less than the estimated frost depth for central Massachusetts of approximately four feet (U.S. Navy, 1982); however, VLDPE geomembrane barriers have been shown to be less susceptible to frost than clay or clay/soil barriers.

The Army believes this conceptual design meets the general performance standards of 310 CMR 19.112. The conceptual design would be reviewed and refined during the final design phase to optimize the balance between top/side slopes and runoff/drainage concerns. If required by MADEP, the Army may seek to further demonstrate that the proposed cover system will adequately protect public health, safety, and the environment pursuant to 310 CMR 19.113.

For cost estimating purposes of this FS, cover system material quantities have been estimated for an area of approximately 4.4 acres to incorporate extension of the cover system layers beyond the limits of landfill debris. Quantity calculations for cover system materials are contained in Appendix D.

Wetland Restoration. The wetlands restoration program proposed for the Landfill Capping/Sediment Removal Alternative is similar to that proposed for the Alternative CSBL-2, but for a larger area. The northern edge of the low-permeability cover system, and the additional length of access road proposed for this alternative would extend beyond the limits of the landfill into Cold Spring Brook Pond. Areas of sediment excavation, temporary access road construction, and ditch excavation at the toe of the cover system would be backfilled and graded, and some areas potentially revegetated. For cost estimating purposes, the extent of wetland restoration for this alternative is assumed to be approximately 1.5 acres.

Cover System Monitoring and Maintenance. Massachusetts Solid Waste Management Regulations (310 CMR 19.142) require the post-closure monitoring period to extend a minimum of 30 years. Proposed cover system monitoring and maintenance at the Cold Spring Brook Landfill would consist of conducting semi-annual site inspections, performing needed cover system repairs, and mowing.

Inspections would be conducted to ensure the integrity of the landfill cover system layers, surface water diversion trenches, monitoring wells, access roads, and the general site conditions. Required maintenance activities would be proposed and conducted based on information from the site inspections. Proposed post-closure groundwater monitoring is described in Subsection 5.1.1.

5.3.2 Remedial Alternative Evaluation

The assessment of this alternative using the evaluation criteria is presented in the following subsections.

5.3.2.1 Overall Protection of Human Health and the Environment. Alternative CSBL-3 has significant potential for protecting human health and the environment under both current and future land use conditions. Alternative CSBL-3 provides all of the protection of Alternative CSBL-2 plus a low-permeability cover system on the Cold Spring Brook Landfill. Placement of the cover system would block infiltration of precipitation to the landfilled debris, reducing potential future contaminant leaching from waste materials in the unsaturated zone.

5.3.2.2 Compliance with ARARs. Table 5-8 provides a summary of the ARARs analysis for Alternative CSBL-3. Subsection 5.2.2.2 discusses compliance of ARARs for sediment and drum removal, which are also a part of this alternative. This subsection will describe how placement of a low-permeability cover system will comply with ARARs. Although a cover system will be installed, it is not known if chemical-specific ARARs will be met for bis(2-ethylhexyl)phthalate and manganese.

Placement of a cover system would not trigger any additional location-specific ARARs. An additional action-specific ARAR, the Massachusetts Solid Waste Management Regulations (310 CMR 19.000) would be relevant and appropriate for this alternative. Alternative CSBL-3 would be designed to meet the performance standards and post-closure requirements of this ARAR. The top and side slopes of the proposed cover vary slightly from Massachusetts general design standards, and if required by MADEP, the Army may seek to further demonstrate that the design meets the requirements for an Alternative Landfill Final Cover System Design pursuant to 310 CMR 19.113.

5.3.2.3 Long-term Effectiveness and Permanence. The long-term effectiveness of the cover system at controlling potential future releases from the unsaturated zone of the landfill would depend on the maintenance of cap integrity. If adequately installed and maintained, low-permeability cover systems have a history of effectively reducing surface infiltration to landfilled waste, promoting surface water drainage, minimizing erosion, and isolating landfilled materials from the environment.

Along the northeastern toe of the landfill, debris can be seen in contact with water and it is not known how much debris is in contact with groundwater within the landfill. A landfill cover system would not reduce potential future releases from the saturated zone. Consideration must be given during the design of the toe of the landfill cover system, to ensure that groundwater flow to the pond is not interrupted by cover system layers.

As for Alternative CSBL-2, the long-term effectiveness of this alternative at preventing potential human exposure also depends on enforcement of institutional controls and the long-term groundwater monitoring program.

The effectiveness of sediment and drum removal is discussed in Subsection 5.2.2.3.

5.3.2.4 Reduction of Toxicity, Mobility, and Volume. Placement of a low-permeability cover system at the Cold Spring Brook Landfill may reduce mobility of potential contaminants in the unsaturated zone, and may also reduce the volume of potential future leachate from the landfill because the volume of infiltration would be reduced. A cover system would not reduce the mobility or volume of potential future leachate from the saturated zone. A cover system would not decrease the toxicity of any potential releases from the landfill.

The reduction of mobility, toxicity and volume from sediment and drum removal is discussed in Subsection 5.2.2.4.

5.3.2.5 Short-term Effectiveness. This alternative would present minimal short-term risks to workers and the community, but would present some short-term risks to the environment. Risk to the community would be minimal because residences are not close enough to the site to be impacted by noise or dust potentially generated from cover system placement activities. Construction of the cover system would require delivery of approximately 33,000 cy of materials. This could

result in an average of 42 dump truck (12 cy capacity) deliveries per day to Fort Devens during the approximate three month construction period. Several routes and entry points to Fort Devens exist, and it is anticipated that deliveries can be planned to avoid creating traffic congestion and hazards. In addition, rerouting of traffic on the section of Patton Road south of the Cold Spring Brook Landfill would be evaluated. Inclusion of this section of the road and an area to the south of Patton Road included in the exclusion zone used during cover system placement and sediment and drum removal would facilitate remedial activities.

RCRA and DOT regulations affecting handling and transportation of any potentially hazardous soils/sediments would reduce the risk of community exposure to an uncontrolled release of hazardous materials.

Grading the landfill prior to capping could present potential risk to workers if hazardous materials are uncovered. Exposure to potentially contaminated soil and debris could be reduced to a safe level by worker adherence to general health and safety practices, and use of personnel monitoring during any intrusive activities at the landfill.

Implementation of Alternative CSBL-3 will result in several short-term adverse effects to the environment. The installation of the proposed cover system would require cutting and clearing the established tree and grassed areas. This would temporarily displace current biota and destroy their habitat. Reconstruction of the landfill slope leading down to Cold Spring Brook Pond would require some excavation in the pond and possibly the construction of a temporary access road along the edge of the pond. This and proposed sediment removal activity would destroy existing wetland habitat. The vegetation of the landfill cover and wetland restoration program would restore/replace these affected areas.

Additional short-term effectiveness issues related to sediment and drum removal, and long-term groundwater monitoring are discussed in Subsection 5.2.2.5.

5.3.2.6 Implementability. Implementability of institutional controls, sediment and drum removal and installation and monitoring of groundwater monitoring wells at the Cold Spring Brook Landfill is discussed in Section 5.2.2.6. Cover system construction can be accomplished using standard construction procedures and conventional earthmoving equipment. Many engineering and construction companies are qualified to design and construct a landfill cover system. Materials

required to construct a low-permeability cover system include approximately 14,200 cy of sand, 9,600 cy of common borrow, 7,100 cy of vegetative soil, 2,250 cy of riprap, and 192,000 sf of geomembrane, all of which are readily available. Post-closure monitoring and maintenance are easily implementable.

Partial dewatering of the Cold Spring Brook Pond, and construction of a temporary access road are implementable, but would require extra engineering precautions and time to create a stable work platform and cover footing while minimizing impacts to the pond and associated wetland. To stabilize the toe of the slope of the cover system, it would most likely be necessary to excavate to stable sands beneath the sediment.

Installation of the cover system could increase the scope of potential future remedial actions at the site, if these actions required access to the debris.

Placement of the cover system would not require any permits, because it is an on-site activity. Post-closure technical requirements of the Massachusetts Solid Waste Management Regulations (310 CMR 19.000) would be met by this alternative. During construction of the cover system, stormwater runoff would be controlled to minimize the quantity of sediments and contaminants entering the pond. In addition, the same requirements as described for Alternative CSBL-2 would be required for the dewatering, additional dredging, and access road construction proposed for this alternative.

5.3.2.7 Cost. In addition to the cost items listed for Alternative CSBL-2 in Subsection 5.1.2.7, direct capital costs for Alternative CSBL-3 include additional site preparation and mobilization of equipment to place the low-permeability cover, and an additional area of wetlands restoration. Additional O&M costs refer to expenditures associated with cover system maintenance. Table 5-9 summarizes the cost estimate for Alternative CSBL-3. The total direct and indirect cost is estimated to be $2,956,000. The present worth of O&M costs is estimated to be $512,000. The estimated total present worth of Alternative CSBL-3 is $3,468,000. Cost calculations are contained in Appendix A.

5.4 ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL

This subsection describes the Landfill Excavation/Drum and Hot Spot Sediment Removal Alternative, evaluates the alternative using the seven evaluation criteria, and provides a cost estimate.

5.4.1 Description

The Landfill Excavation/Drum and Hot Spot Sediment Removal Alternative proposes hot spot sediment removal and drum removal as described in the Alternative CSBL-2. In addition, Alternative CSBL-4 proposes excavation and removal of the debris in the Cold Spring Brook Landfill. Although the landfill has not been shown to be a current source of groundwater contamination, this alternative proposes excavation of the Cold Spring Brook Landfill to eliminate the landfill as a potential future source of groundwater and sediment contamination. The landfill debris would be consolidated at a consolidation facility that would be constructed at Fort Devens. Institutional controls and educational programs are not proposed, because the presumed source of potential future groundwater contamination would be removed. The following specific actions are included in this alternative:

- Site Preparation and Mobilization
- Sediment Removal and Disposal (see Subsection 5.2.1)
- Drum Removal and Disposal (see Subsection 5.2.1)
- Landfill Excavation
- Wetlands Restoration
- Consolidation of Excavated Debris at Consolidation Facility
- Cover System Monitoring and Maintenance at Consolidation Site
- Environmental Monitoring
- Five-year Site Reviews

Each of these actions is described in the following paragraphs.

Site Preparation and Mobilization. Site preparation and mobilization for this alternative includes all site preparation activities and mobilization of equipment described in Subsection 5.2.1. In addition, a stockpile area approximately one acre in size would be constructed at the location of the consolidation location to

store landfill liner and cover system materials. Additional equipment requiring mobilization include backhoes, dump trucks, front-end loaders and bulldozers to excavate debris from the Cold Spring Brook Landfill, transport the debris, and place it at the consolidation location.

Landfill Excavation. As described in Subsection 4.1, an estimated 100,000 cy of material would require excavation at Cold Spring Brook Landfill.

Debris would be excavated from on top of the landfill in a manner to minimize the amount of pond water entering the excavation. Pumps may be required to remove groundwater that collects in the excavation area. Settling or filtration of the groundwater may be necessary to prevent exceedances of AWQC in Cold Spring Brook Pond.

Based on available information, it is concluded that material within Cold Spring Brook Landfill is non-hazardous. The landfill will be treated as a debris landfill, and the debris excavated and consolidated at another Fort Devens location.

Wetland Restoration. The same wetlands restoration program proposed for Alternative CSBL-2 is proposed for the Landfill Excavation/Sediment Removal Alternative, but for a larger area. Excavation activities along the northeastern edge of the landfill may disturb portions of Cold Spring Brook Pond, where debris is close to the edge or protruding into the pond. Therefore, in addition to restoring the areas of sediment excavation and temporary access road construction, sections of Cold Spring Brook Pond that are disturbed would be backfilled, graded, and potentially revegetated. For cost estimating purposes, the extent of wetland restoration for this alternative is assumed to be two and one-half acres.

Construction of Debris Consolidation Facility. This alternative proposes that a debris consolidation facility be identified for placement of the debris excavated from Cold Spring Brook Landfill. A location for this consolidation facility has not been identified, but it should be as close to the Cold Spring Brook Landfill as possible, to minimize the costs of hauling debris. For the cost estimating purposes of this FS, the consolidation facility is assumed to be constructed at an existing Fort Devens landfill, a maximum distance of four miles from Cold Spring Brook Landfill. Supplemental design to provide capacity for debris, operation, and

closure of this facility would be carried out in accordance with the Massachusetts Solid Waste Management Facility Regulations 310 CMR 19.000 Parts I and II.

This FS discusses a conceptual design for the consolidation facility based on the requirements of 310 CMR 19.110 and 19.112 (Figure 5-3). If this alternative is selected, alternative design components and methodologies to improve performance and/or reduce costs will be evaluated during the design phase.

The cost estimate for this alternative is based on construction of an approximately 12-acre landfill with a capacity of 211,000 cy plus daily cover (estimated at ten percent of debris volume). The 211,000 cy volume is adequate for the consolidation of several solid waste landfills at Fort Devens that may require excavation. The cost per cubic yard capacity for construction, operation, and maintenance of this consolidation landfill was used to estimate the cost for disposal of debris excavated from the Cold Spring Brook Landfill.

The conceptual consolidation landfill used for cost estimating is roughly rectangular in shape with the length approximately twice the width, and had three-to-one side slopes, five percent top slope and two percent bottom slope. Waste thickness was 14 feet at the top of the side slope, and a maximum of approximately 28 feet at the center.

The conceptual consolidation facility includes a groundwater protection system to provide an effective hydraulic barrier to prevent leachate from reaching groundwater, and to collect landfill leachate for disposal. The groundwater protection system would consist of a subgrade layer, a hydraulic barrier layer, and a drainage layer with leachate collection pipes. The composite hydraulic barrier would consist of 24-inches of compacted soil with a maximum in-place saturated hydraulic conductivity of 1×10^{-7} cm/sec, overlain by a geomembrane. An 18-inch sand drainage layer is proposed above the geomembrane. The lower 12 inches of sand would have a minimum hydraulic conductivity of 1×10^{-2} cm/sec with leachate collection pipes spaced 50 feet on center. The sand layer and the leachate collection pipes would provide a high permeability pathway for leachate collection. The upper six inches of the drainage layer would have a minimum hydraulic conductivity of 1×10^{-3} cm/sec. Leachate will be collected in a 5,000-gallon storage tank, buried below frost line beyond the limits of the cover system. As required by Massachusetts regulations, the storage tank would incorporate secondary containment or a leak detection system. It is assumed that

stormwater collection would only be required for one construction season while the consolidation facility is open and accepting debris from the Cold Spring Brook Landfill. During this active phase, a berm would be constructed at the perimeter of the facility to enable containment of a 25-year, 24-hour storm event. Stormwater generated from the active facility, and leachate from the closed landfill would be transported by a leachate collection pipe to the underground storage tank. The water level in the storage tank would be monitored, and the water removed and disposed of as required.

Debris excavated from the Cold Spring Brook Landfill and other Fort Devens landfills would be placed and compacted in this consolidation facility. When transfer of material is complete, the facility will be closed and a low-permeability cover system constructed in accordance with 310 CMR 19.000. Figure 5-3 shows the groundwater protection and 36-inch-thick cover system build-up used for cost estimating. Quantity calculations for facility materials are shown in Appendix F.

Cover System Monitoring and Maintenance for Consolidation Facility. Massachusetts Solid Waste Management Regulations (310 CMR 19.142) require the post-closure monitoring period to extend a minimum of 30 years. Proposed monitoring and maintenance activities for the consolidation facility would consist of semi-annual site inspections and mowing.

Inspections would be conducted to ensure the integrity of the landfill liner, cover, and leachate collection and storage systems, diversion trenches, monitoring wells, access roads, and the general site conditions. Required maintenance activities would be proposed and conducted based on information from the site inspections. The landfill surface would be mowed semi-annually. Proposed post-closure groundwater monitoring is described in the environmental monitoring subsection below.

Environmental Monitoring. A groundwater and sediment monitoring program similar to that proposed for Alternative CSBL-2 (Subsection 5.2.1), but at a reduced frequency and for a reduced time period, is proposed for this alternative.

Because this alternative proposes excavation and removal of the potential future source of groundwater and sediment contamination, groundwater monitoring is proposed semi-annually for only five years, and sediment monitoring would be conducted only once following excavation of landfilled debris and hot spot

sediments. Monitoring locations and analytical parameters for groundwater and sediment monitoring are presented in Tables 5-2 and 5-5, respectively.

A groundwater monitoring program is proposed for 30 years, at monitoring wells installed upgradient and downgradient of the consolidation facility. The cost estimate assumes installation of two upgradient and four downgradient wells. Monitoring parameters for the groundwater monitoring program at the consolidation facility are assumed to be the same as those listed in Table 5-2, plus VOCs.

Five-year Site Reviews. Five-year site reviews would be conducted for this alternative as described in Subsection 5.2.1. Data collected from groundwater and sediment monitoring at Cold Spring Brook Landfill would be presented in the first five-year review. Review of this data would determine if any future monitoring is required at Cold Spring Brook Landfill. Continuing five-year site reviews would be conducted to review groundwater monitoring data collected from the consolidation facility.

5.4.2 Remedial Alternative Evaluation

The assessment of this alternative using the evaluation criteria is presented in the following subsections.

5.4.2.1 Overall Protection of Human Health and the Environment. Alternative CSBL-4 has significant potential for achieving an acceptable level of risk for human and ecological receptors. Alternative CSBL-4 would provide the same protectiveness as Alternative CSBL-2 at Cold Spring Brook Landfill, with sediment and drum removal and groundwater monitoring. In addition, this alternative would prevent potential future releases from landfill debris to groundwater and Cold Spring Brook Pond sediment by excavating the soil and debris from the Cold Spring Brook Landfill, and disposing it in a consolidation facility at Fort Devens. However, moving the landfill debris to a separate consolidation facility would transfer the risk of potential releases to another location.

5.4.2.2 Compliance with ARARs. Table 5-10 provides a summary of the ARARs analysis for Alternative CSBL-4. Excavation and removal of landfilled debris would prevent any potential future releases to groundwater or sediment.

Although landfill debris would be removed, it is not known if this alternative would achieve chemical-specific ARARs for bis(2-ethylhexyl)phthalate and manganese.

No additional location-specific ARARs would be triggered by landfill excavation or placement of debris at a consolidation facility.

Several action-specific ARARs apply to this alternative. ARARs related to dredging and transportation and disposal of sediment and drums would be followed as described in Subsection 5.2.2.2. In addition, design and construction, operation and closure of a consolidation facility would be performed in accordance with the Massachusetts Solid Waste Management Regulations (310 CMR 19.000). Construction and operation of the consolidation facility may generate particulate emissions. These will be managed through engineering controls.

5.4.2.3 Long-Term Effectiveness and Permanence. Removal of the landfill as a potential source of future groundwater contamination, and removal of hot spot sediments and drums would effectively prevent human and ecological exposure. Groundwater monitoring for five years would adequately monitor potential changes in groundwater quality following the removal of the landfill. The effectiveness of the consolidation facility at isolating Cold Spring Brook Landfill debris, would depend on the quality of construction and proper maintenance of cover and leachate collection systems. Landfills which include groundwater protection systems with leachate collection, cover systems and long-term monitoring and maintenance have a history of effectively isolating wastes from the environment.

5.4.2.4 Reduction of Toxicity, Mobility or Volume through Treatment. No treatment technologies are employed for this alternative to reduce toxicity, mobility or volume of potential contaminants in the landfill debris. Mobility of potential contaminants in the debris would be reduced by disposing them in a lined landfill cell with leachate collection. Reduction of toxicity, mobility, and volume for sediments and drummed contents is discussed in Subsection 5.2.2.4.

5.4.2.5 Short-term Effectiveness. This alternative is expected to present minimal risks to workers, the community, and the environment. Approximately 100,000 cy of debris would be transported to the consolidation facility. Up to 30 20-cy

dumptruck loads per day would be required to transport debris to the consolidation facility during a three month excavation period. Transportation of materials would be planned to avoid creating traffic congestion and hazards to the community. To further protect the community, traffic on Patton Road would be rerouted during removal of soil and debris from the Cold Spring Brook Landfill. Handling and transportation of any hazardous materials would be conducted according to RCRA and DOT regulations to protect workers and the community.

As for previous alternatives, excavation of sediment, drums, and landfilled debris could present a risk to workers if hazardous materials are encountered. Worker adherence to general health and safety practices, and use of personnel monitoring would reduce potential exposure to a safe level. Excavation of landfilled debris and construction of the consolidation facility could generate dust. Dust suppression techniques would reduce potential risk to workers and the community.

Excavation activities at the Cold Spring Brook Landfill would be conducted to minimize impact on the environment. Excavation would be conducted to minimize pond water entering the excavation. In addition, stormwater runoff and groundwater flow into the excavation would be controlled to minimize the quantity of sediment and contaminants entering the pond. As stated in Subsection 5.2.2.5, construction of the temporary access road along the northwest toe of the landfill may adversely affect the environment, but wetland restoration activities would minimize any permanent impact. The consolidation facility would be located and constructed according to regulations to minimize impact to the environment.

5.4.2.6 Implementability. The implementability of sediment and drum removal, and installation and monitoring of groundwater monitoring wells is discussed in Subsection 5.2.2.6.

Landfill excavation and construction can be accomplished using standard construction procedures and conventional earthmoving equipment, and many engineering and construction companies are qualified and available. Successful implementation of this alternative is contingent on the approval and construction of a consolidation facility to accept the excavated debris. The consolidation facility would be constructed and maintained to effectively isolate Cold Spring Brook Landfill debris. Implementation of this alternative would not limit or

interfere with the ability to perform future remedial actions at Cold Spring Brook Landfill.

All activities to excavate Cold Spring Brook Landfill for this alternative would be conducted on-site, and permits would not be required. At the Cold Spring Brook Landfill, stormwater runoff would be controlled to minimize the quantity of sediments and contaminants entering the pond. Design, construction, operation, closure, and post-closure monitoring and maintenance of the consolidation facility would be conducted according to the technical requirements of Massachusetts 310 CMR 19.000.

5.4.2.7 Cost. Direct capital costs for Alternative CSBL-4 include site preparation and mobilization, sediment removal and disposal, drum removal and disposal, landfill excavation, wetlands restoration, disposal of debris at a consolidation facility, and demobilization. O&M costs include groundwater and sediment monitoring at the site of the Cold Spring Brook Landfill and five-year site reviews. The costs of long-term monitoring and operation and maintenance at the consolidation facility are included in the cost estimate for that facility. Table 5-11 summarizes the cost estimate for Alternative CSBL-4. The total direct and indirect cost is estimated to be $3,494,000. The present worth of O&M costs is estimated to be $189,000. The estimated unit cost of waste disposal at a Fort Devens solid waste consolidation facility is $31.05/cy or a total of $3,105,000 for 100,000 cy. The estimated total present worth of Alternative CSBL-4 is $6,788,000. Cost calculations are contained in Appendix A.

6.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The following paragraphs present a comparison of the four remedial alternatives, (Alternatives CSBL-1, CSBL-2, CSBL-3, and CSBL-4) highlighting the relative advantages and disadvantages of the alternatives with respect to the seven evaluation criterion. The evaluation is performed in order to assist decision-makers in selecting a remedy that best meets the remedial action objectives. Results of the evaluation are summarized in Table 6-1.

6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

CERCLA requires that this threshold criterion be met for a remedial alternative to be chosen as a final site remedy. At Cold Spring Brook Landfill, potential human health risks exceeding USEPA criteria were associated with future residential exposure to groundwater. There is no current residential exposure to groundwater. All of the alternatives except CSBL-1 provide some degree of protection for human health. Although Alternative CSBL-1 includes a long-term groundwater monitoring program, no action is proposed to reduce future exposure or potential risk. Alternative CSBL-2 retains the groundwater monitoring program of Alternative CSBL-1, and adds institutional controls to limit potential future residential exposure to groundwater and provide protection of human health. Alternative CSBL-3 includes installing a low-permeability cap at the landfill to limit infiltration and reduce potential leaching of contaminants to groundwater. Alternative CSBL-3 also includes the groundwater monitoring program and institutional controls of Alternative CSBL-2.

Alternative CSBL-4 provides protection of human health by excavating the Cold Spring Brook Landfill and transporting landfill debris to a consolidation facility. Although this achieves high levels of protectiveness at Cold Spring Brook Landfill, it transfers any potential risk of releases to another Fort Devens location. It includes the groundwater monitoring program of the other alternatives, but does not include institutional controls to limit future residential exposure to groundwater.

Exposure to pond sediments contaminated with arsenic and lead is a potential source of ecological risk. Alternative CSBL-1 provides no measures to reduce potential adverse ecological effects. Alternatives CSBL-2, CSBL-3, and CSBL-4 all reduce

ecological risk by dredging sediments at two hot spot locations in Cold Spring Brook Pond.

Alternatives CSBL-2, CSBL-3, and CSBL-4 also all propose the removal and disposal of discarded drums observed at the landfill. Removal of the drums will prevent potential groundwater and sediment contamination by the drum contents.

6.2 COMPLIANCE WITH ARARS

CERCLA requires that the selected alternative also meet a second threshold criterion of compliance with ARARs, or obtain a waiver if the criterion can not be met. Location-specific ARARs identified for the Cold Spring Brook Landfill Operable Unit include regulations that protect wetlands and floodplains. Alternative CSBL-1 would not trigger any wetland or floodplain ARARs. Alternatives CSBL-2, CSBL-3, and CSBL-4 all involve activities (i.e., sediment dredging, drum removal, and landfill capping or excavation) that will impact wetlands. Under federal and Commonwealth laws and regulations, detrimental activities must be avoided if possible. If detrimental activities cannot be avoided, then disturbed areas must be restored. Alternatives CSBL-2, CSBL-3, and CSBL-4 would achieve compliance with these ARARs through restoration actions. All the alternatives will meet the requirements of the Fish and Wildlife Coordination Act to coordinate remedial activities with federal regulators by continued submittal of project documents.

All of the alternatives utilize groundwater monitoring to evaluate long-term effectiveness. Alternatives CSBL-2, CSBL-3, and CSBL-4 also include sediment and biological monitoring.

Chemical-specific ARARs exist for two of the groundwater COPCs (arsenic and bis[2-ethylhexyl]phthalate) at the Cold Spring Brook Landfill Operable Unit. Available monitoring data indicate that the arsenic MCL of 50 μg/L is not exceeded at the Cold Spring Brook Landfill Operable Unit. The MCL of 6 μg/L for bis(2-ethylhexyl)phthalate was exceeded by the RME concentration of 14 μg/L, but was not exceeded by the average exposure concentration of 4 μg/L evaluated during the Risk Assessment of the RI Addendum Report. ARARs are not exceeded at the nearby Patton Well.

Chemical-specific ARARs have not been established for sediments.

The four alternatives will meet all action-specific ARARs.

Potential remedial actions at Cold Spring Brook Landfill and in Cold Spring Brook Pond are considered "on-site" and therefore otherwise applicable permits would not have to be obtained.

6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion evaluates the magnitude of residual risk and the reliability of controls after response objectives have been met. Alternative CSBL-2 relies on institutional controls to reduce potential residential exposure to groundwater.

Institutional controls require cooperation among landowners and government agencies to be effective, and are often considered not to be very reliable. However, the unique groundwater flow pattern at Cold Spring Brook Landfill and the fact that zoning and deed restrictions can be implemented during base-closure activities significantly increases the potential for institutional controls to be effective in this instance.

In addition to institutional controls, Alternative CSBL-3 would install a low-permeability cap over the landfill. A properly designed and maintained cap will reduce infiltration to landfill debris; however, the potential reduction in contaminant leaching and migration of contaminants to groundwater and sediment cannot be quantified. It is likely that a portion of landfill debris will remain in contact with groundwater.

Implementation of Alternative CSBL-4 would result in excavation and removal of the Cold Spring Brook Landfill. This would remove the landfill as a potential source of groundwater and sediment contamination at its present location; however, current releases from the landfill are not quantified and therefore quantification of the benefit of removal of the landfill is difficult. Although precautions would be taken at the consolidation facility to prevent releases, transfer of landfill debris to that facility would also transfer the potential for release.

Drum and hot spot sediment removal, a part of Alternatives CSBL-2, CSBL-3, and CSBL-4, would provide long-term effectiveness in eliminating these media as potential release sources and points of exposure.

All of the alternatives include groundwater monitoring as a means to evaluate long-term effectiveness. Alternatives CSBL-2, CSBL-3, and CSBL-4 also include sediment and biological monitoring.

6.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion evaluates whether the alternatives meet the statutory preference for treatment under CERCLA. The criterion evaluates the reduction of toxicity, mobility, or volume of contaminants, and the type and quantity of treatment residuals. None of the four alternatives rely on treatment as a primary component of remedial activities.

No reduction of toxicity, mobility, or volume would occur as part of Alternative CSBL-2. Drum and hot spot sediment removal actions of Alternatives CSBL-2, CSBL-3, and CSBL-4 will reduce the on-site toxicity, mobility, and volume of contaminants by removing these materials. Landfill capping as part of Alternative CSBL-3 will potentially reduce the mobility of contaminants in unsaturated landfill materials. Landfill excavation as part of Alternative CSBL-4 and consolidation of debris at a consolidation facility will also reduce the mobility of contaminants in landfill materials.

6.5 Short-term Effectiveness

CERCLA requires that potential adverse short-term effects to workers, the surrounding community, and the environment be considered during selection of a remedial action. Adverse short-term effects to site workers are not expected for any of the alternatives. However, because of increasing amounts of construction activities, potential hazards to workers increase with Alternatives CSBL-2, CSBL-3, and CSBL-4. Cold Spring Brook Landfill is not suspected of containing hazardous materials, therefore worker exposure to hazardous materials is not anticipated. Workers would need to follow a site-specific HASP and follow prudent safety precautions during any invasive or construction activities.

Remedial actions would not be implemented as part of Alternative CSBL-1, therefore adverse short-term effects on the community are not foreseen. The major adverse short-term effects on the community for Alternatives CSBL-2, CSBL-3, and CSBL-4 are associated with the increased volume of truck and vehicle traffic that will result. Alternative CSBL-3 will generate more traffic than Alternative CSBL-2, and Alternative CSBL-4 will generate more traffic than Alternative CSBL-3. Special traffic flow planning and control would be needed for each of these alternatives.

Adverse short-term ecological effects are not predicted for Alternative CSBL-1, however, increasing levels of short-term effects would be expected for Alternatives CSBL-2, CSBL-3, and CSBL-4. The drum removal activities of Alternative CSBL-2 would likely adversely affect small areas of wetland/pond bottom (perhaps a few hundred to one- or two-thousand square feet). Hot spot sediment dredging would directly effect approximately one-half acre of pond bottom and gaining access to the sediments would likely affect some bordering wetland. The adverse short-term effects of Alternatives CSBL-3 and CSBL-4 include not only the effects of sediment dredging but also of removing/destroying the established habitat on the landfill surface. Installation of the cap and landfill excavation would also adversely affect the pond bottom and wetland bordering the landfill. It is expected that landfill excavation would cause greater disruption than landfill capping. Wetland restoration activities would be designed to mitigate short-term adverse effects to wetland areas.

6.6 IMPLEMENTABILITY

This criterion evaluates each alternative's ease of construction and operation; administrative feasibility; and availability of services, equipment, and materials to construct and operate the alternative. Also evaluated is the ease of undertaking additional remedial actions.

Although the engineering complexity increases for each alternative (i.e., CSBL-4 > CSBL-3 > CSBL-2 > CSBL-1), engineering and construction services, equipment, and materials should be readily available to implement any of the alternatives. Because Cold Spring Brook Landfill and Cold Spring Brook Pond are both wholly on U.S. Army property, the implementation of institutional controls in the form of zoning and deed restrictions should be readily implementable as part of the base-closure process. The increasing amount of disturbance of wetland and habitat for Alternatives CSBL-2, CSBL-3, and CSBL-4; the fact that installing a cover system in

Alternative CSBL-3 may increase the scope and complexity of potential future remedial actions; and the need to identify a suitable debris consolidation facility for Alternative CSBL-4, are all differentiators of implementability of these remedial alternatives.

6.7 COST

Capital, O&M, and present worth costs were estimated for each alternative. Cost estimates for all four alternatives included similar costs for long-term groundwater monitoring, and cost estimates for Alternatives CSBL-2, CSBL-3, and CSBL-4 included similar costs for drum and sediment removal. The alternatives with the lowest capital costs are CSBL-1 and CSBL-2 because they do not include extensive construction activities. Alternative CSBL-3 has a relatively high capital cost because it includes construction of a low-permeability cap at Cold Spring Brook Landfill. Alternative CSBL-4 has the highest capital cost because it includes excavation of the debris at Cold Spring Brook Landfill and subsequent disposal of the debris at a consolidation facility.

After calculation of the present worth for each alternative, the sensitivity of the costs to the estimating assumptions was evaluated. The costs associated with Alternative CSBL-1 consist primarily of long-term groundwater monitoring costs. A relative high degree of certainty is associated with the long-term groundwater monitoring. In addition, review of estimating variables suggests that uncertainty in estimating long-term groundwater monitoring costs will not affect alternative selection because these costs are relatively low and common to all alternatives; therefore, further sensitivity analysis was not performed for Alternative CSBL-1.

The major cost associated with Alternative CSBL-2 is for sediment removal and disposal. Some uncertainty exists in the estimation of the quantity of sediment to be excavated. An effort was made to reduce some of the sensitivity of cost to this variable by increasing the estimated removal volume from approximately 900 to 1,200 cy (see Subsection 4.1). If sediment removal quantities were to double to 2,400 cy, the estimated capital cost for Alternative CSBL-2 would increase by approximately $650,000 to $2,168,000, or by 43 percent. Total present worth would increase from $1,980,000 to $2,630,000, or by approximately 33 percent. Since Alternatives CSBL-3 and CSBL-4 also include sediment removal, their cost estimates would also increase by equal dollar amounts (but not percentages) if sediment removal quantities

doubled. The relative ranking of costs among alternatives would not be affected, however.

Alternatives CSBL-2, CSBL-3, and CSBL-4 also each include drum removal and disposal. The estimated drum removal costs have a relatively high degree of certainty. Furthermore, drum removal costs are a relatively small component of capital costs for these three alternatives and uncertainty in the number of drums to be disposed (up to a several fold increase) or disposal costs would not affect relative costs among alternatives. Therefore, further cost sensitivity analysis was not performed for drum removal.

The majority of costs associated with Alternative CSBL-3 is for construction of a low-permeability landfill cap. The cost estimate for Alternative CSBL-3 is potentially sensitive to the landfill area to be capped, and to the cost of construction materials. A relatively high degree of certainty is associated with these variables; however, and further sensitivity analysis was not performed.

The majority of costs associated with Alternative CSBL-4 is for the excavation of Cold Spring Brook Landfill and subsequent disposal of debris at a consolidation facility. The cost estimate for this alternative is potentially sensitive to two key variables: 1) the volume of material to be excavated, and 2) the unit cost of disposal. The 100,000 cy estimate of the volume to be excavated at Cold Spring Brook Landfill is considered a conservative estimate, if the assumption that debris was not used as a base for reconstruction of Patton Road holds true. If debris was used as a road base, then up to a 500-foot segment of roadbed and shoulder where realignment occurred could require excavation at an average width of approximately 70 feet and depth of 6 feet: approximately 7,800 cy. Excavation and disposal costs would therefore increase approximately 8 percent or by $306,000. An additional $140,000 would be required to backfill the excavation and replace the excavated segment of Patton Road. The total increase in capital cost associated with this additional excavation would be approximately $580,000 or 17 percent. Total present worth would increase by $580,000 to $7,368,000, or by approximately 9 percent.

The unit cost (i.e., cost per cubic yard) for disposal of Cold Spring Brook Landfill debris was based on consolidation at a facility designed to hold approximately 211,000 cy. These unit costs are expected to decrease relatively slowly as the design capacity of the consolidation facility increases and to increase relatively rapidly as design capacity of the consolidation facility decreases. The greatest effect on disposal

costs would be observed if the consolidation facility was constructed only for the disposal of 100,000 cy of debris excavated from Cold Spring Brook Landfill. To evaluate this effect, a cost estimate was prepared for construction of a 100,000 cy consolidation facility (Appendix E). Comparison of the cost estimates in Appendix E indicates that disposal cost would increase from approximately $31/cy for a 211,000 cy facility to approximately $42/cy for 100,000 cy facility. This would result in an approximate $1,080,000 increase in the total present worth of Alternative CSBL-4 from $6,788,000 to $7,866,000, or by 16 percent.

ABB-ES	ABB Environmental Services, Inc.
AOC	Area of Contamination
ARARs	Applicable or Relevant and Appropriate Requirements
ASL	above sea level
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
cm/sec	centimeters per second
COPC	Chemical of Potential Concern
cy	cubic yards
DDD	2,2-bis(para-chlorophenyl)-1,1-dichloroethane
DDE	2,2-bis(para-chlorophenyl)-1,1-dichloroethene
DDT	2,2-bis(para-chlorophenyl)-1,1,1-trichloroethane
DOT	U.S. Department of Transportation
ER-L	effects range - low
ER-M	effects range - medium
ET	exposure time
FDA	U.S. Food and Drug Administration
FFA	Federal Facility Agreement
FS	Feasibility Study
gpm	gallons per minute
HASP	Health and Safety Plan
HI	Hazard Index
HQ	Hazard Quotient
IAG	interagency agreement
IRIS	Integrated Risk Information System

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MCP	Massachusetts Contingency Plan
NCBMP	National Contaminant Biomonitoring Program
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NOAA	National Oceanic and Atmospheric Administration
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PAL	Project Analyte List
PCB	polychlorinated biphenyl
POTW	publicly owned treatment works
PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SMCL	Secondary Maximum Contaminant Levels
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	to-be-considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TOC	total organic carbon
TSD	treatment, storage and disposal
$\mu g/g$	micrograms per gram

μg/L	micrograms per liter
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VLDPE	very low density polyethylene
VOC	volatile organic compound
WRS	Wetlands Restoration Specification

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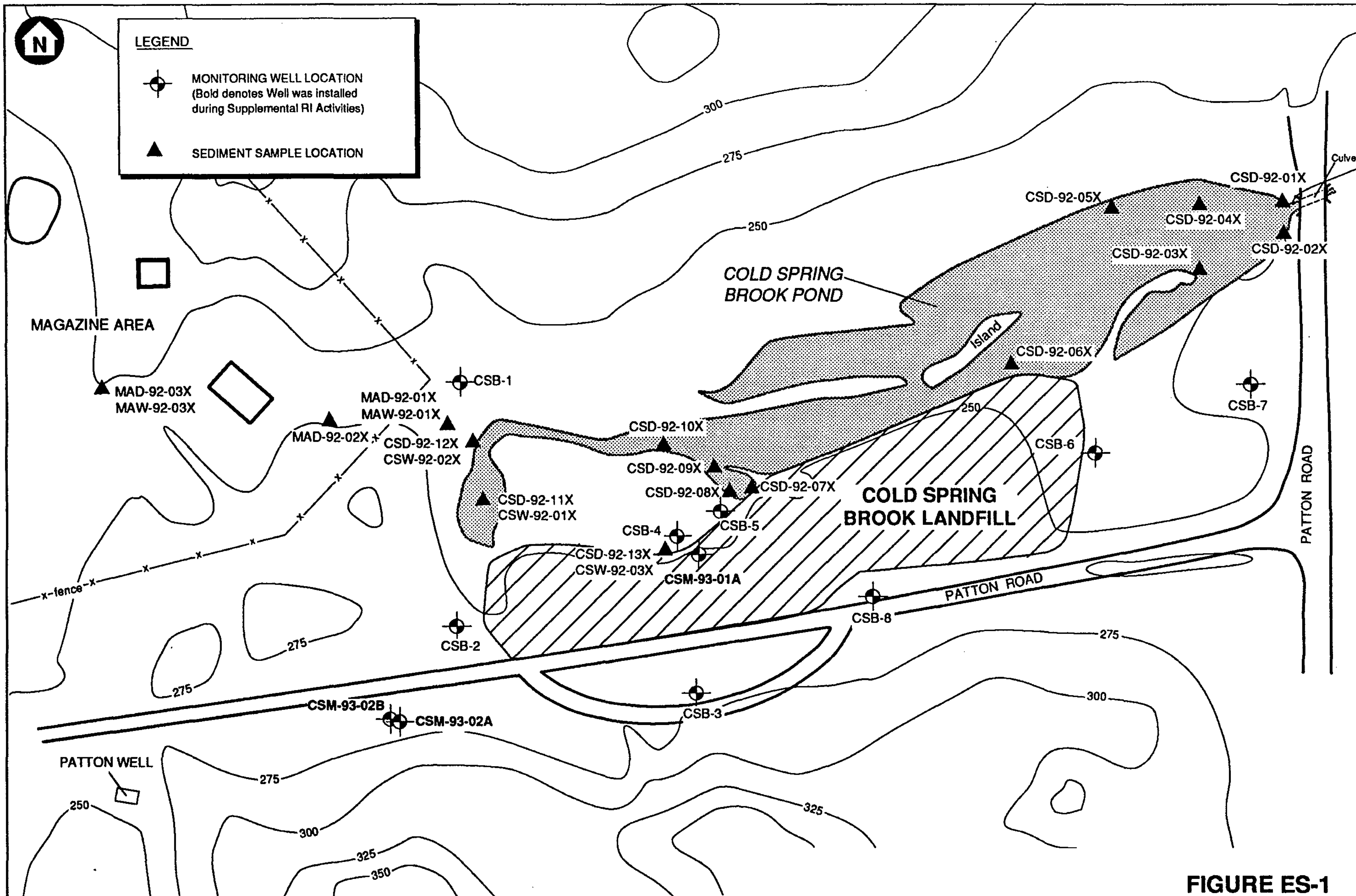

FIGURE ES-1
COLD SPRING BROOK LANDFILL SITE MAP
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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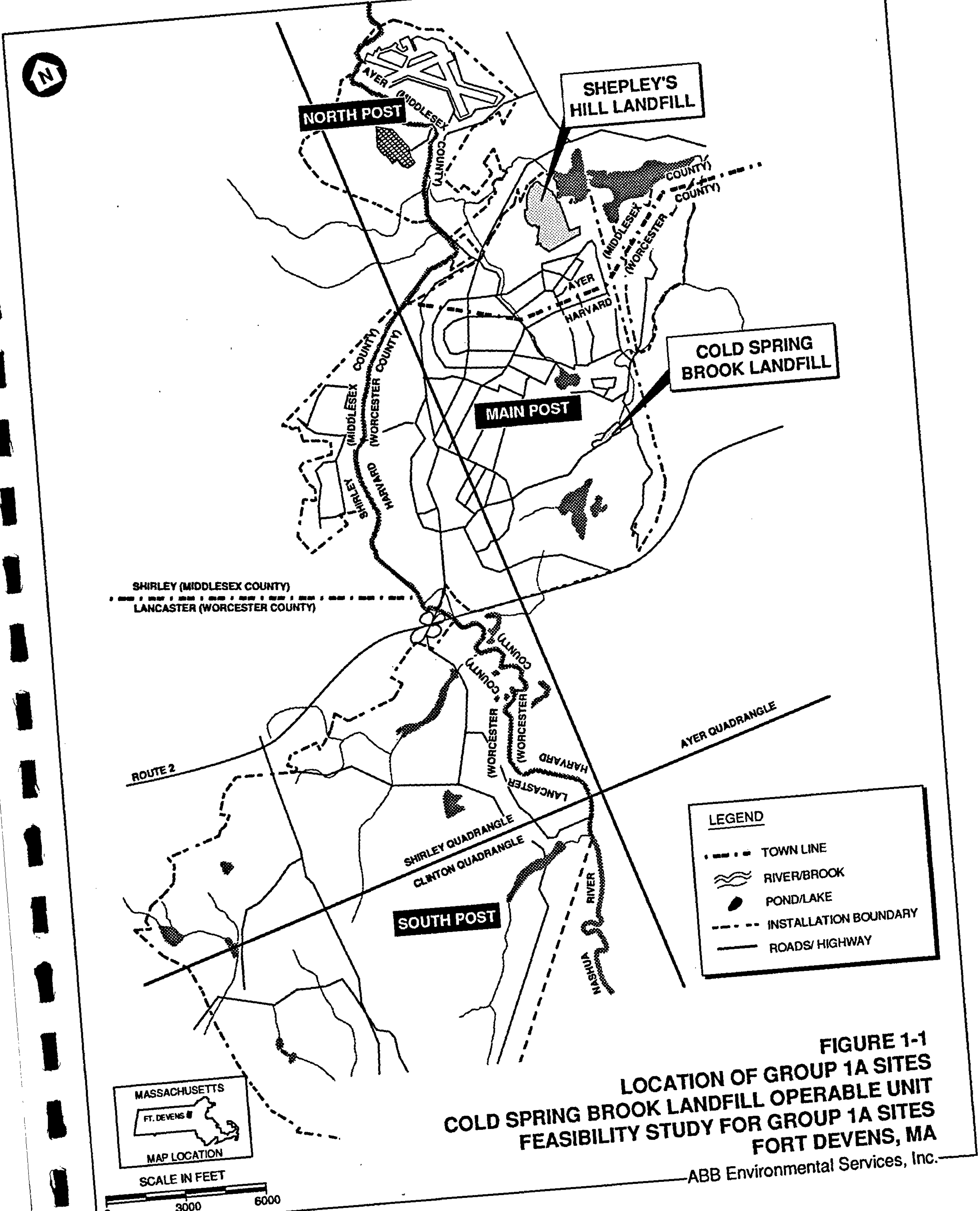

FIGURE 1-1
LOCATION OF GROUP 1A SITES
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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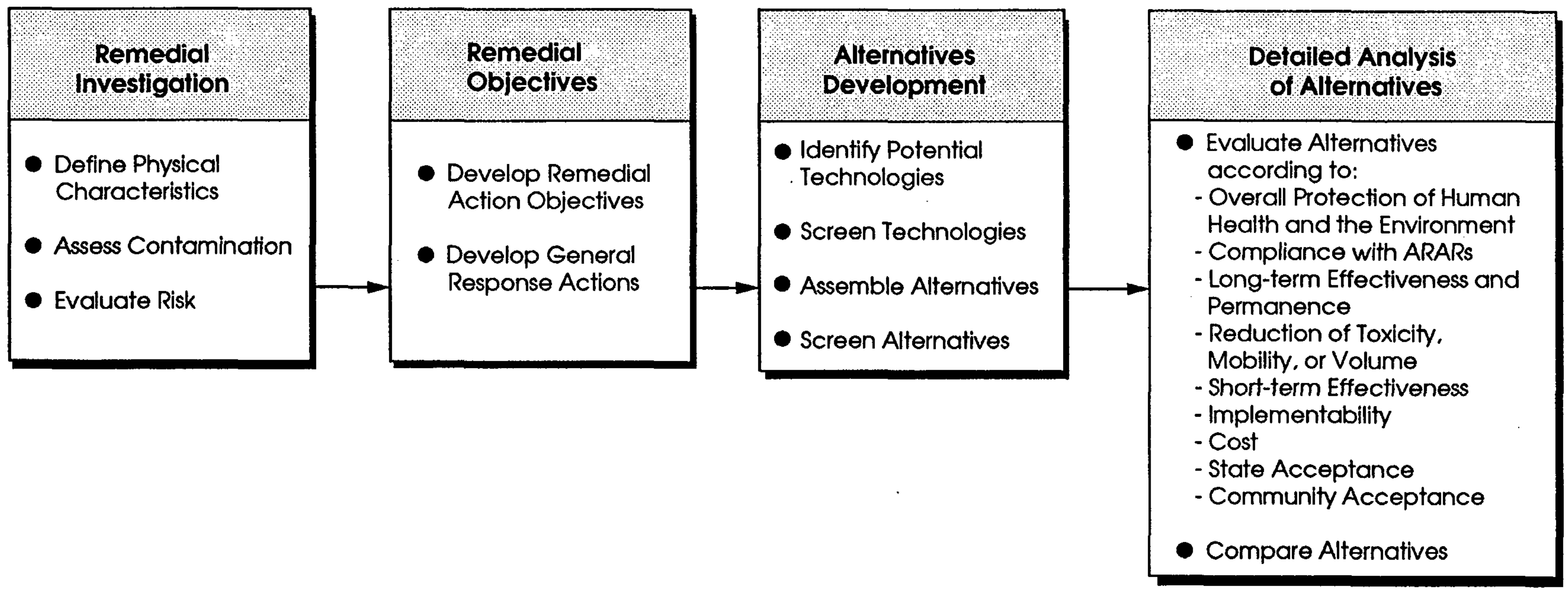

FIGURE 1-2
FEASIBILITY STUDY PROCESS
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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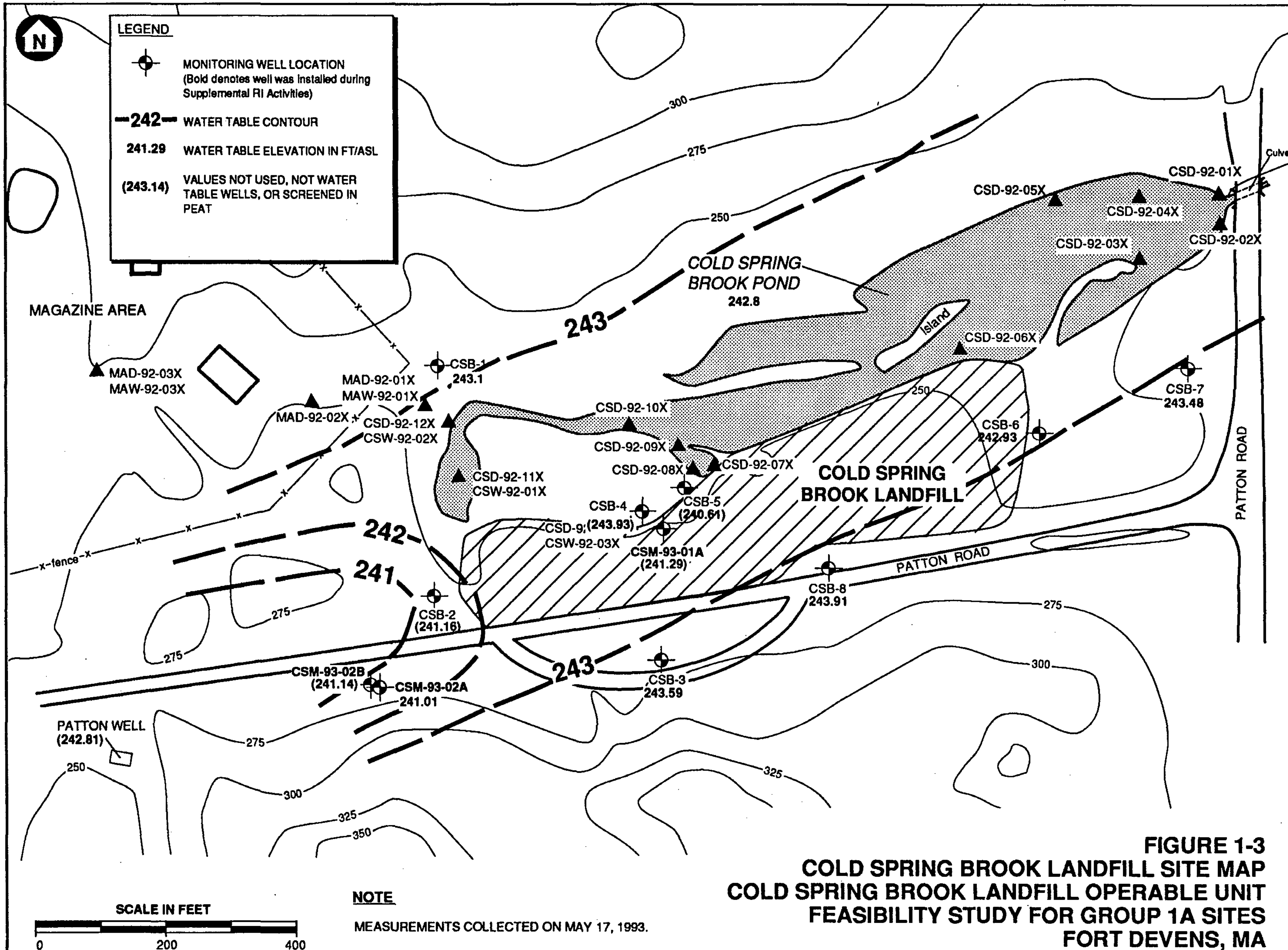

NOTE

MEASUREMENTS COLLECTED ON MAY 17, 1993.

FIGURE 1-3
COLD SPRING BROOK LANDFILL SITE MAP
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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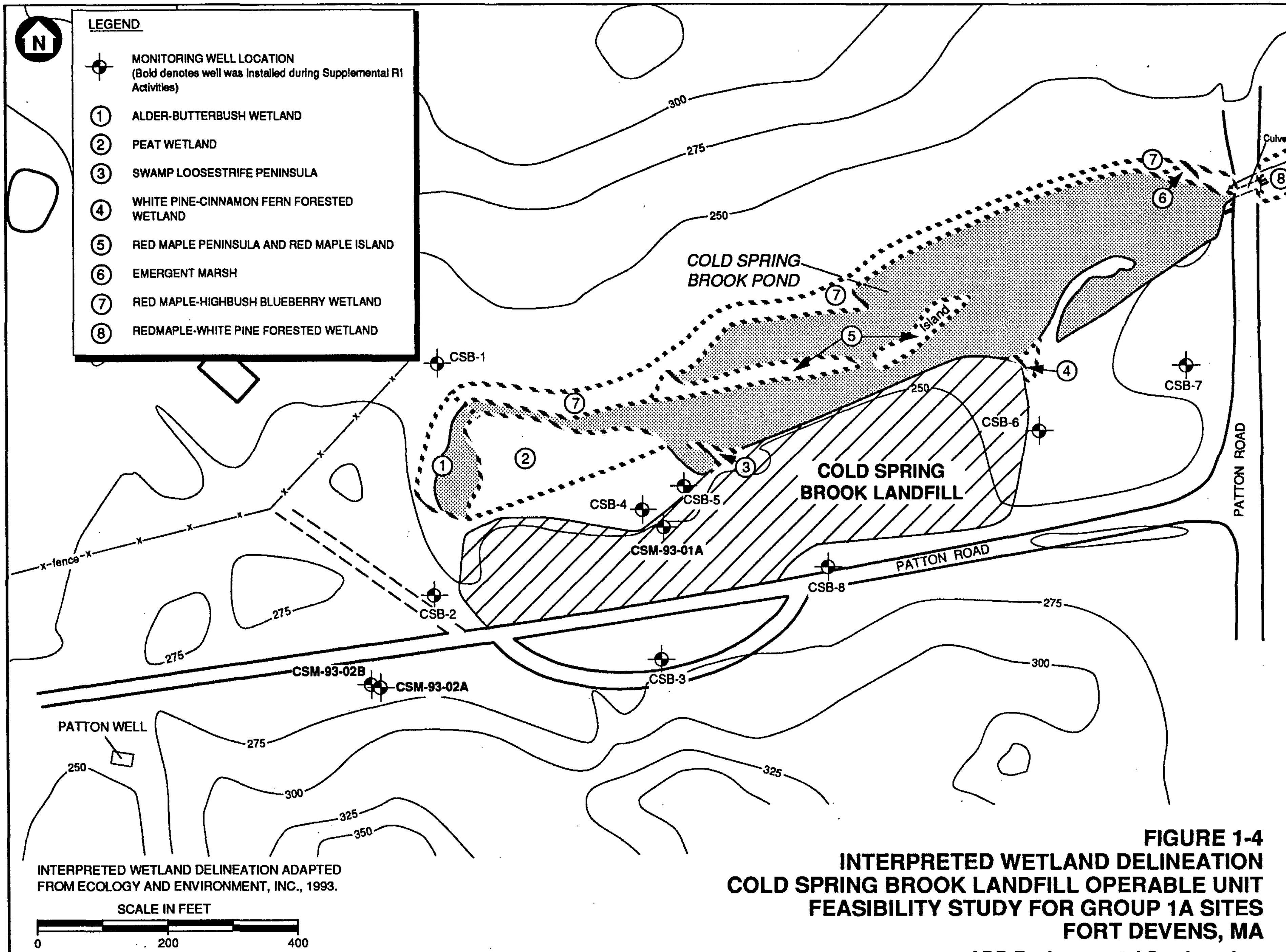

FIGURE 1-4
INTERPRETED WETLAND DELINEATION
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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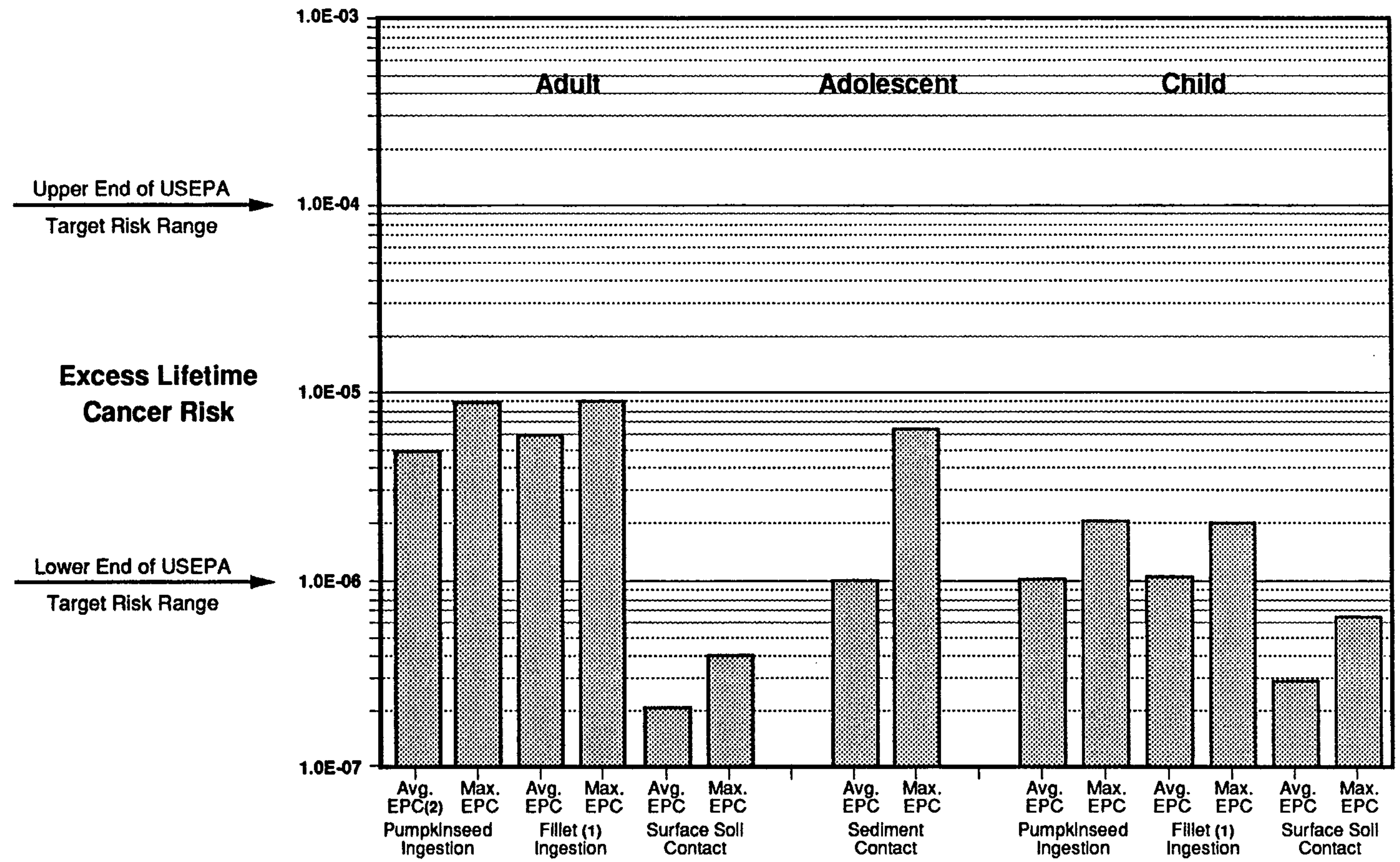

NOTE:

(1) Fillets include bullheads and chain pickerel.

(2) Avg. EPC = average exposure point concentration;
Max. EPC = maximum exposure point concentration.

FIGURE 1-5
SUMMARY OF CANCER RISK ESTIMATES
CURRENT LAND USE
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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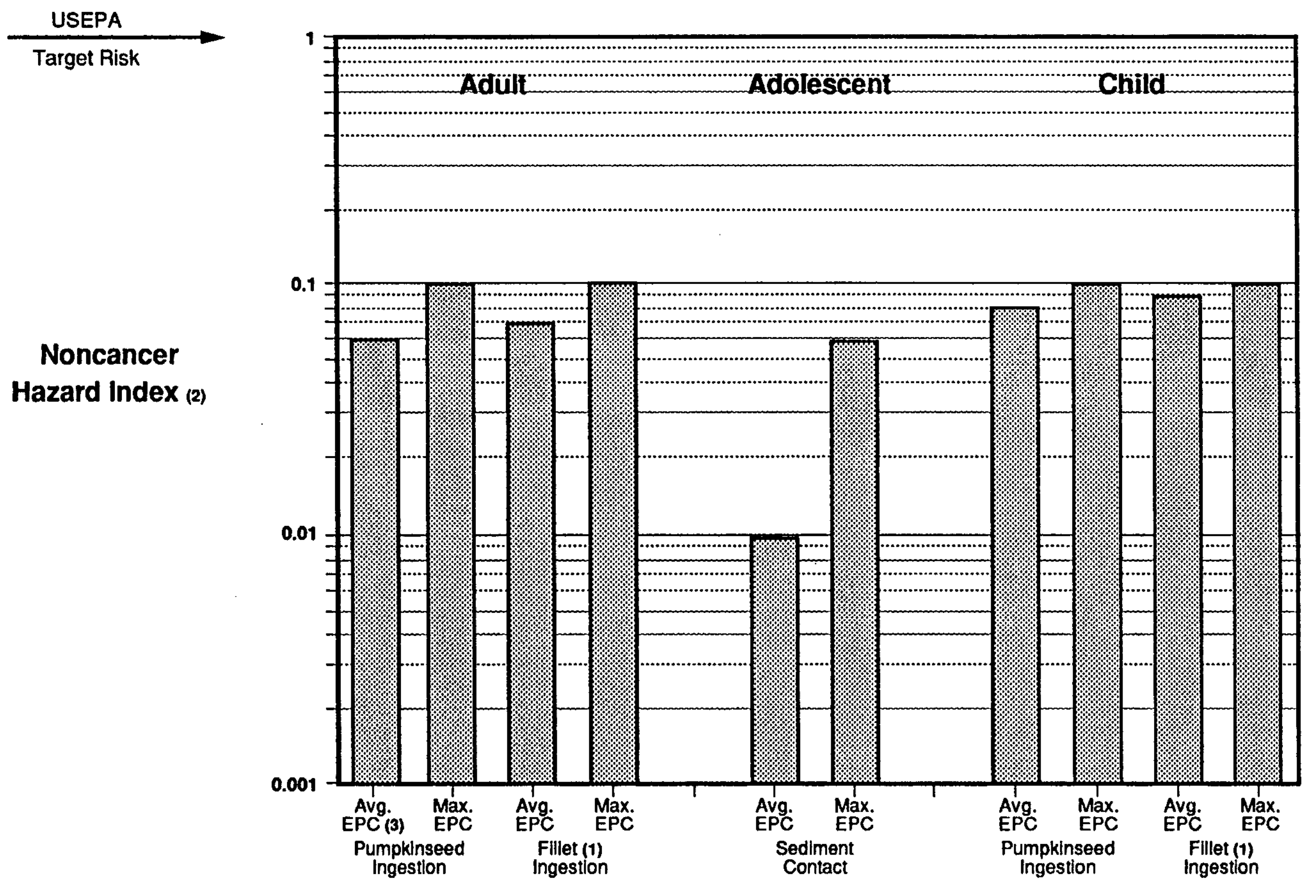

NOTE:

(1) Fillets include bullheads and chain pickerel.

(2) Hazard indices associated with surface soil contact for adult and child are $1x10^{-4}$ or less.

(3) Avg. EPC = average exposure point concentration;
Max. EPC = maximum exposure point concentration.

FIGURE 1-6
SUMMARY OF NONCANCER RISK ESTIMATES
CURRENT LAND USE
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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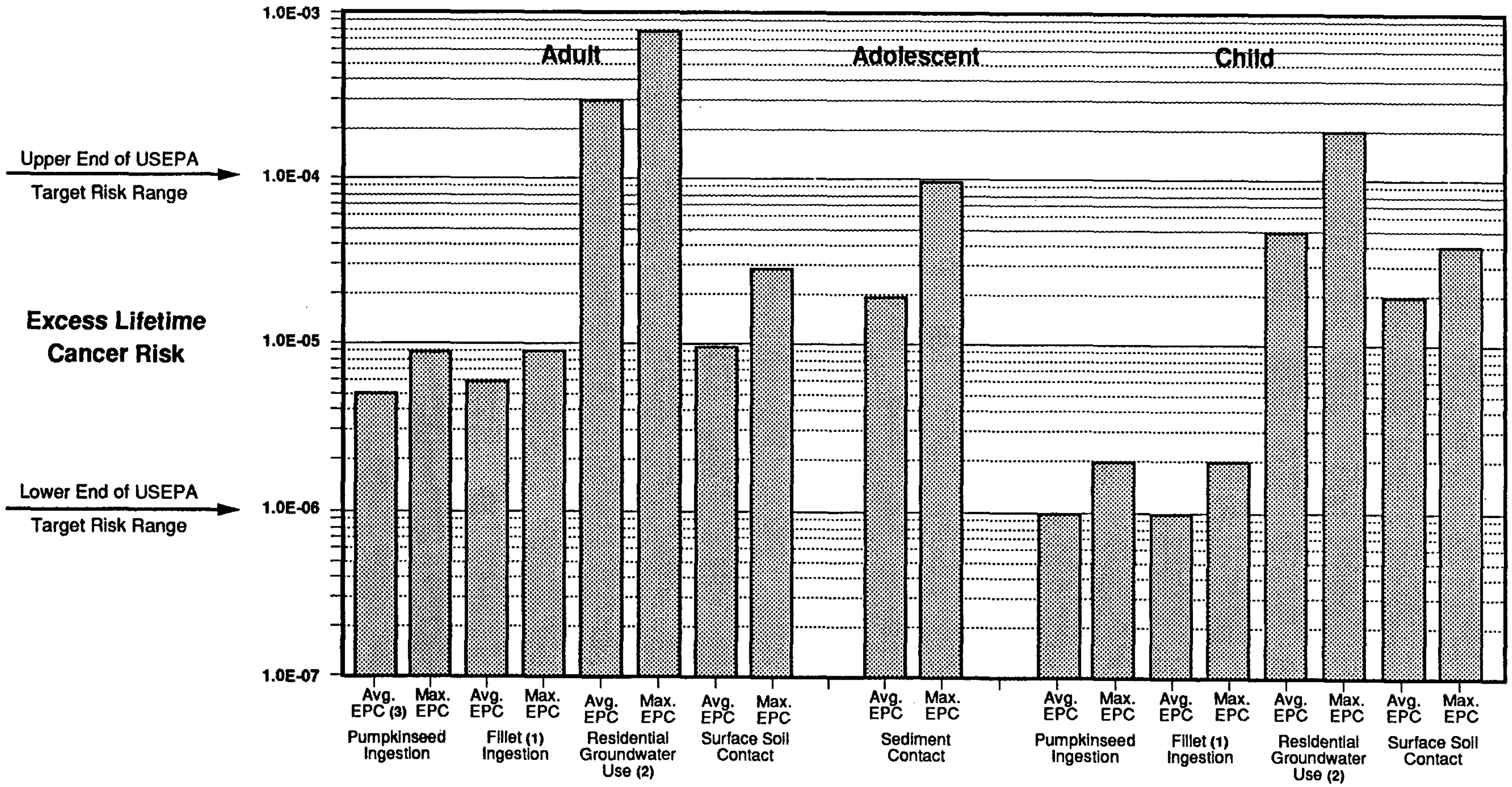

NOTE:

(1) Fillets include bullheads and chain pickerel.

(2) Unfiltered groundwater.

(3) Avg. EPC = average exposure point concentration;
Max. EPC = maximum exposure point concentration.

FIGURE 1-7
SUMMARY OF CANCER RISK ESTIMATES
FUTURE LAND USE
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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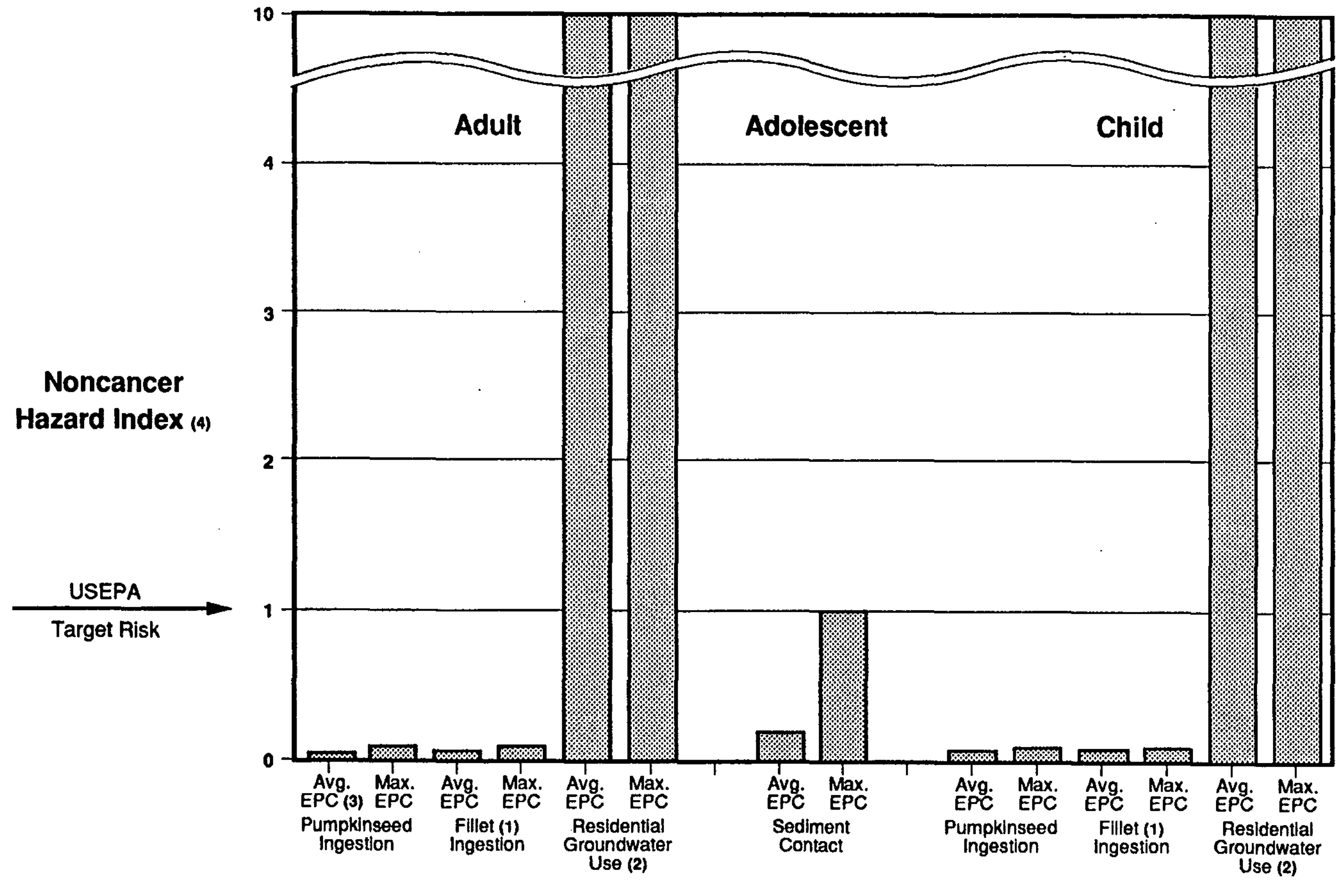

NOTE:

(1) Fillets include bullheads and chain pickerel.

(2) Unfiltered groundwater.

(3) Avg. EPC = average exposure point concentration;
Max. EPC = maximum exposure point concentration.

(4) Hazard indices for surface soil contact for adult and child are 0.007 or less.

FIGURE 1-8
SUMMARY OF NONCANCER RISK ESTIMATES
FUTURE LAND USE
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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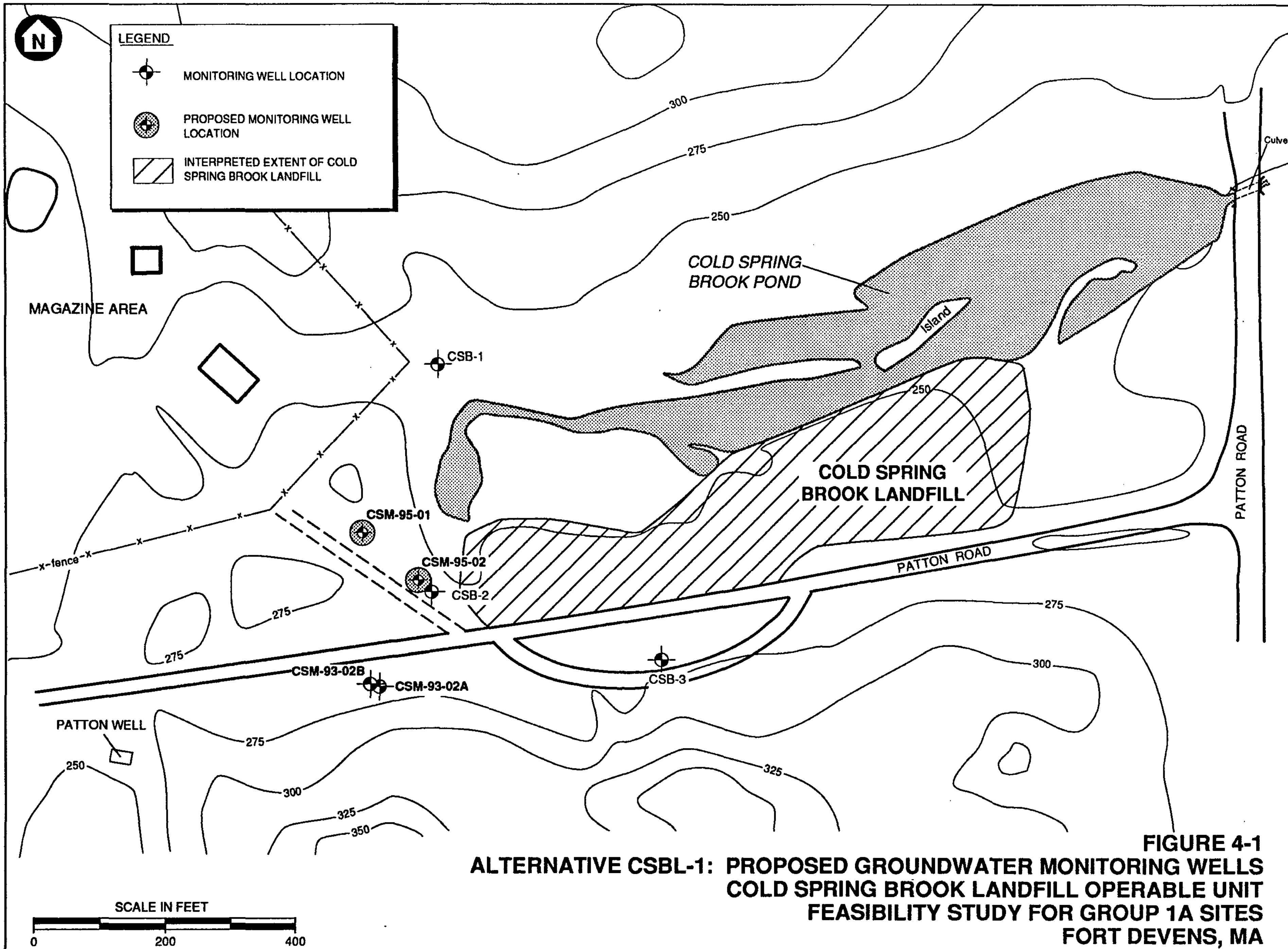

FIGURE 4-1
ALTERNATIVE CSBL-1: PROPOSED GROUNDWATER MONITORING WELLS
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA
ABB Environmental Services, Inc.

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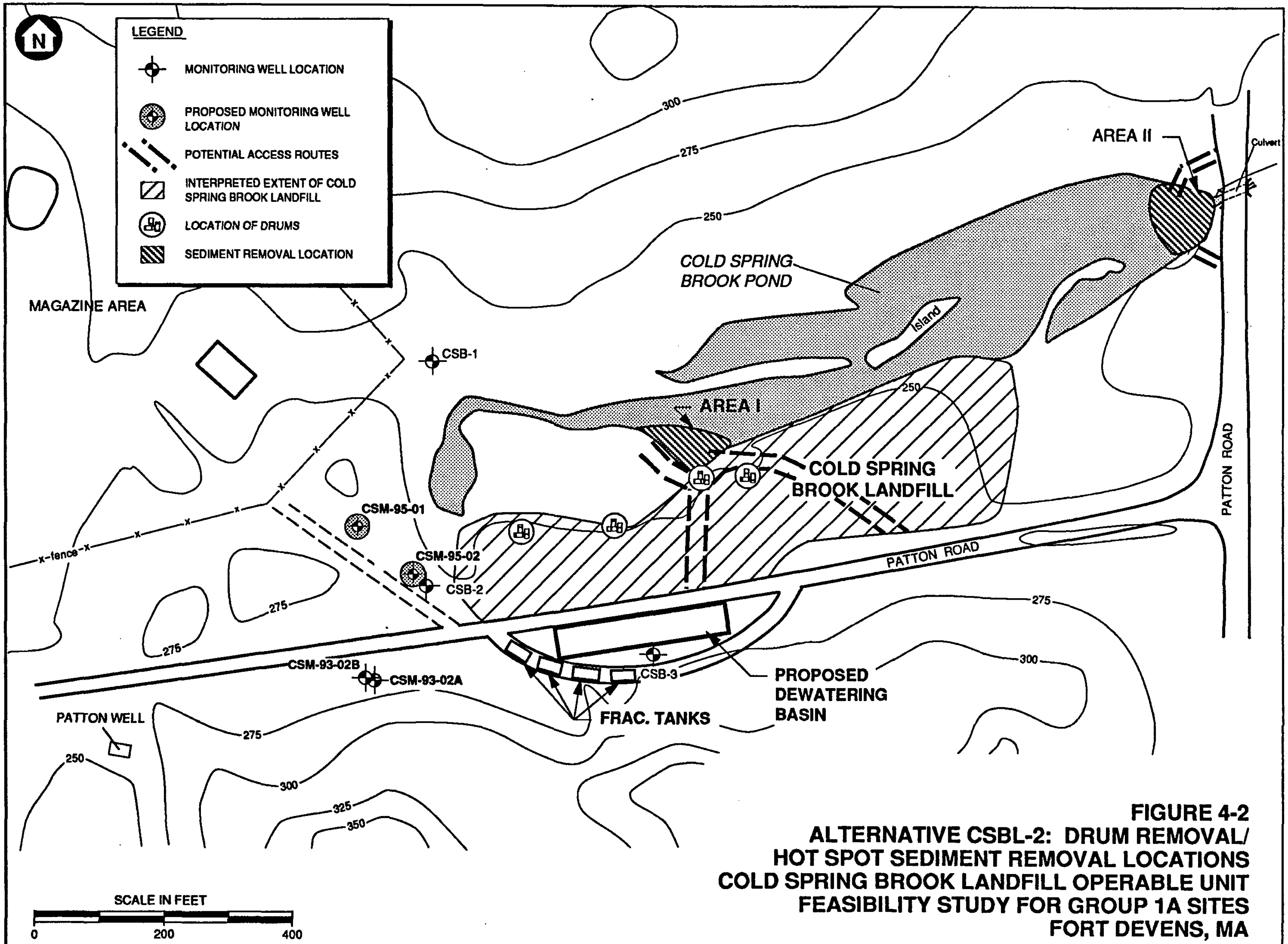

FIGURE 4-2
ALTERNATIVE CSBL-2: DRUM REMOVAL/ HOT SPOT SEDIMENT REMOVAL LOCATIONS
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

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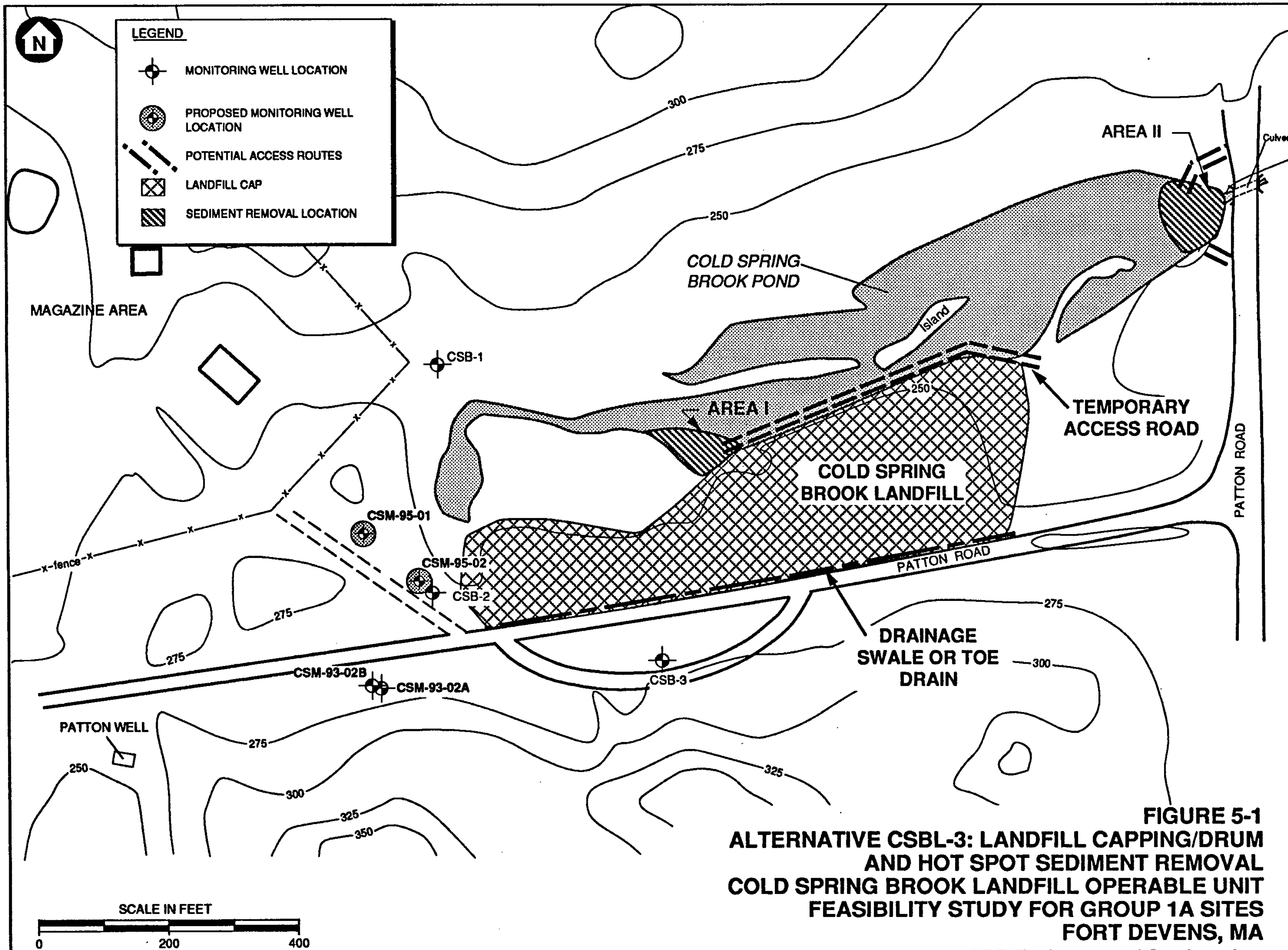

FIGURE 5-1
ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ABB Environmental Services, Inc.

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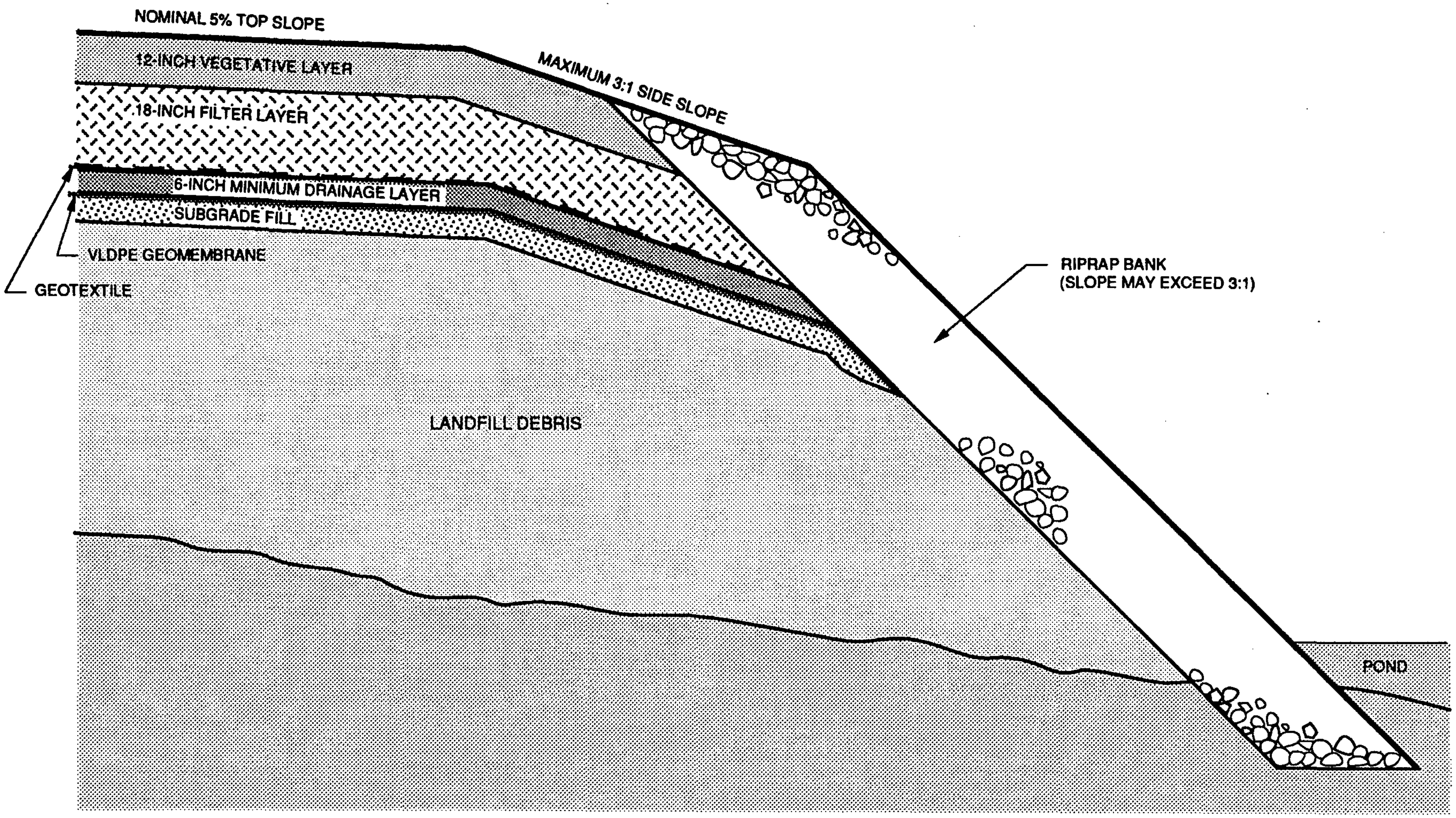

NOT TO SCALE

FIGURE 5-2
ALTERNATIVE CSBL-3: COVER SYSTEM FOR EXISTING LANDFILL
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITE S
FORT DEVENS, MA

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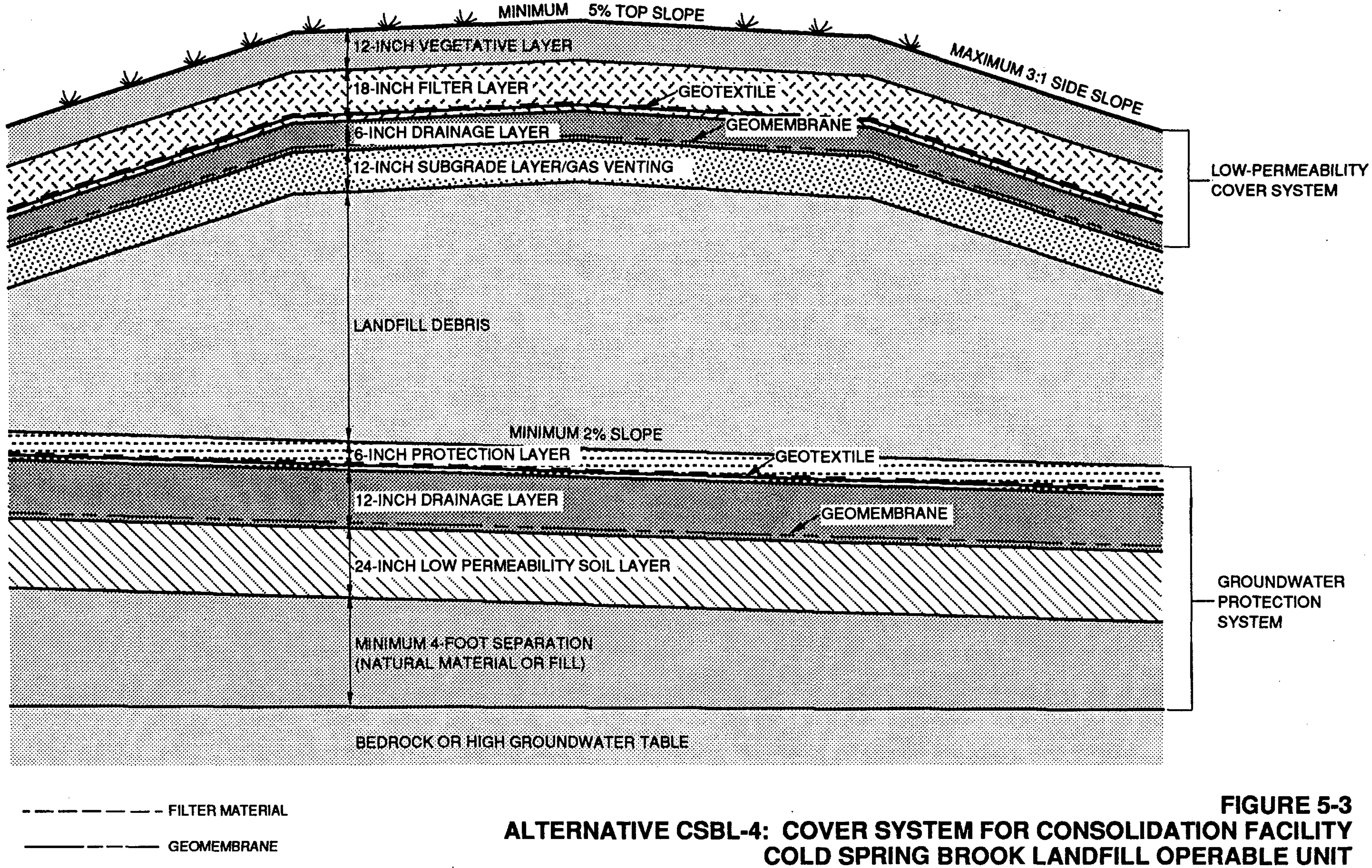
ABB Environmental Services, Inc.



NOT TO SCALE

FIGURE 5-3
ALTERNATIVE CSBL-4: COVER SYSTEM FOR CONSOLIDATION FACILITY
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

TABLE 1–1
CHEMICALS EXCEEDING EVALUATION CRITERIA

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

CHEMICAL	GROUNDWATER	POND SEDIMENT	POND SURFACE WATER		SURFACE SOIL
			H.H. AWQC	Eco. AWQC	
VOLATILE ORGANIC COMPOUNDS					
2–Butanone		X			
SEMIVOLATILE ORGANIC COMPOUNDS					
Acenaphthene		X			
Acenaphthylene		X			
Anthracene		X			X
Benzo(a)anthracene		X			X
Benzo(a)pyrene		X			X
Benzo(b)fluoranthene		X			X
Benzo(k)fluoranthene		X			X
Benzo(g,h,i) perylene					X
Bis(2–ethylhexyl)phthalate	X	X			
Carbazole		X			
Chrysene		X			X
Dibenzofuran		X			
Fluoranthene		X			X
Fluorene		X			
Indeno(1,2,3–C,D) pyrene		X			X
Naphthalene		X			
Phenanthrene		X			X
Pyrene		X			X
PESTICIDES/PCBs					
DDD		X			X
DDE		X			X
INORGANICS					
Aluminum	X	n.a.			
Arsenic	X	X	X		X
Barium	X	X			X
Beryllium		n.a.			
Calcium	X	n.a.			X
Chromium	X	X			X
Cobalt		n.a.			
Copper	X	X		X	X
Iron	X	X	X	X	X
Lead	X	X			
Magnesium	X	n.a.			X
Manganese	X	X	X		X
Mercury					X
Nickel	X	X			X
Potassium	X	n.a.			X
Selenium	X	n.a.			
Silver		n.a.		X	
Sodium	X	n.a.			X
Vanadium	X	n.a.			X
Zinc	X	X		X	X

Notes:
H.H. AWQC = Ambient Water Quality Criteria for protection of human health.
Eco. AWQC = Ambient Water Quality Criteria for protection of aquatic life.
n.a. = Sediment evaluation criteria not available.

TABLE 1-2
CONTAMINANT CONCENTRATIONS IN
COLD SPRING BROOK LANDFILL WELLS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

	UNFILTERED SAMPLES			FILTERED SAMPLES		
COMPOUND	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION µ/L	MAXIMUM CONCENTRATION µ/L	FREQUENCY OF DETECTION	AVERAGE CONCENTRATION µ/L	MAXIMUM CONCENTRATION µ/L
SEMIVOLATILE ORGANIC COMPOUND						
Bis(2-ethylhexyl)phthalate	2/4	4	14	n.a.	n.a.	n.a.
INORGANICS						
Aluminum	3/4	3,900	20,000	0/3	n.c.	n.c.
Arsenic	2/4	14	40	1/3	5	20
Barium	4/4	41	112	3/3		37
Calcium	4/4	69,000	164,000	3/3	64,000	148,000
Chromium	1/4	8	31	0/3	3,200	14,600
Copper	2/4	11	31	0/3	n.c.	n.c.
Iron	4/4	9,600	25,000	2/3	n.c.	n.c.
Lead	3/4	4	13	0/3	n.c.	n.c.
Magnesium	4/4	12,000	28,900	3/3	11,500	25,000
Manganese	4/4	2,500	5,700	3/3	3,000	6,100
Nickel	1/4	21	49	0/3	n.a.	n.a.
Potassium	4/4	5,600	8,500	3/3	5,900	17,000
Sodium	4/4	18,000	43,000	3/3	13,200	18,600
Vanadium	1/4	8	26	1/3	8	12
Zinc	1/4	19	60	0/3	n.c.	n.c.

Notes:
Unfiltered samples from wells CSB-2, CSM-93-01A, CSM-93-02A, CSM-93-02B
Filtered samples from wells CSB-2, CSM-93-01A, CSM-93-02A
n.a. = not analyzed
n.c. = not calculated
µ/L = micrograms per liter

TABLE 3-1
SUMMARY OF CANCER RISK ESTIMATES[1]
FUTURE LAND USE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

EXPOSURE SCENARIO	ADULT		ADOLESCENT		CHILD		RISK CONTRIBUTIONS (BY CHEMICAL)
	AVERAGE EPC	MAXIMUM EPC	AVERAGE EPC	MAXIMUM EPC	AVERAGE EPC	MAXIMUM EPC	
Ingestion of Pumpkinseeds	5E-06	9E-06	NA	NA	1E-06	2E-06	Arsenic (81%)
Ingestion of Fillets (bullhead and pickerel)	6E-06	9E-06	NA	NA	1E-06	2E-06	Arsenic (97%)
Sediment Contact	NA	NA	2E-05	1E-04	NA	NA	Arsenic (58%) PAHs (36%)
Surface Soil Contact	1E-05	3E-05	NA	NA	2E-05	4E-05	PAHs (99%)
Residential Groundwater Use (downgradient wells)							
Unfiltered	3E-04	8E-04	NA	NA	5E-05	2E-04	Arsenic [2] (99%)
Filtered	1E-04	4E-04	NA	NA	2E-05	8E-05	Arsenic (100%)
Total Risk[3]							
Unfiltered	3E-04	9E-04	NA	NA	7E-05	2E-04	
Filtered	1E-04	5E-04	NA	NA	4E-05	1E-04	

Notes:
[1]As reported in the Fort Devens Group 1A Sites Final Remedial Investigation Addendum Report (December 1993).
[2]The cancer risk associated with bis(2-ethylhexyl)phthalate slightly exceeds the USEPA point of departure of $1x10^{-6}$ (at $6.5x10^{-6}$), but represents less than 1% of the total risk.
[3]Total risk is calculated for adults who consume fillets, are exposed to surface soil and sediment, and use the groundwater for domestic purposes. For a child, total risk includes fillet ingestion, soil contact, and groundwater use.
EPC= Exposure Point Concentration
NA= Not Applicable
Note: Shaded risk estimates represent updated values, different from those reported in the Final RI Addendum Report (December 1993); an error existed in the December 1993 risk spreadsheets and the shaded risk estimates are corrected values.

TABLE 3-2
SUMMARY OF NONCANCER RISK ESTIMATES[1]
FUTURE LAND USE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

EXPOSURE SCENARIO	ADULT		ADOLESCENT		CHILD		RISK CONTRIBUTIONS[2]
	AVERAGE EPC	MAXIMUM EPC	AVERAGE EPC	MAXIMUM EPC	AVERAGE EPC	MAXIMUM EPC	(BY CHEMICAL)
Ingestion of Pumpkinseeds	0.06	0.1	NA	NA	0.08	0.1	HIs[3]<1
Ingestion of Fillets (bullhead and pickerel)	0.07	0.1	NA	NA	0.09	0.1	HIs<1
Sediment Contact	NA	NA	0.2	1.0	NA	NA	Arsenic (1.0; skin)
Surface Soil Contact	0.0006	0.001	NA	NA	0.004	0.007	HIs<1
Residential Groundwater Use (downgradient wells)							
Unfiltered	20	40	NA	NA	20	40	Manganese (16,37; CNS effects), Arsenic (1,4
Filtered	20	40	NA	NA	20	40	Manganese (19, 39), Arsenic(0.5, 2)
Total Risk[4]							
Unfiltered	20	40	NA	NA	20	40	
Filtered	20	40	NA	NA	20	40	

Notes:
[1]As reported in the Fort Devens Group 1A Sites Final Remedial Investigation Addendum Report (December 1993).
[2]Hazard quotients for individual chemicals shown in parentheses, at average and maximum EPCs, respectively, for receptor showing greatest risk. Toxicity endpoint of dose/response value also shown in parentheses
[3]HIs= hazard indices for mixtures.
[4]Total risk is calculated for adults and children who consume fillets, are exposed to surface soil, and use the groundwater for domestic purposes.
EPC= Exposure Point Concentration
NA= Not Applicable
CNS = Central Nervous System
Note: Shaded risk estimates represent updated values, different from those reported in the Final RI Addendum (December 1993); an error existed in the December 1993 risk spreadsheets and the shaded risk estimates are corrected values.

TABLE 3–3
PROPOSED PRELIMINARY REMEDIATION GOALS
FOR GROUNDWATER AT COLD SPRING BROOK LANDFILL

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

CHEMICAL OF CONCERN	DOWNGRADIENT WELLS				BACKGROUND CONCENTRATION (μg/L)	DRINKING WATER STANDARDS AND GUIDELINES						PROPOSED PRG (μg/L)
	AVERAGE EPC (μg/L)		MAXIMUM EPC (μg/L)			MCL (μg/L)	SMCL (μg/L)	HA (μg/L)	MMCL (μg/L)	MSMCL (μg/L)	ORSG (μg/L)	
	UNFILTERED	FILTERED	UNFILTERED	FILTERED								
Aluminum	3,948	ND	20,500	ND	6,870	–	50 – 200	–	–	50 – 200	–	6,870
Arsenic	14	4.9	40	19.8	10.5	50	–	–	50	–	–	50
Iron	9,593	3,156	25,400	14,600	9,100	–	300	–	–	300	–	9,100
Manganese	2,504	2,983	5,700	6,120	291	–	50	–	–	50	–	291
Sodium	18,081	13,195	42,900	18,600	10,800	–	–	20,000	–	–	28,000	20,000
Bis(2–ethylhexyl)phthalate	4	–	14	–	NA	6	–	–	6	–	–	6

Notes:
EPC = Exposure Point Concentration
ND = Not detected
MCL[1] = Maximum Contaminant Level. (Federal) Enforceable health based standard for public drinking water systems. MCLs are considered relevant and appropriate in ARARs analysis of Section 5.
SMCL[1] = Secondary Maximum Contaminant Level. (Federal) Nonenforceable standard relating to aesthetic qualities and public acceptance of drinking water.
HA[1] = Health Advisory (Federal) A nonenforceable health based guideline for drinking water quality.
MMCL[2] = Massachusetts Maximum Contaminant Level. (Massachusetts) Enforceable health based standard for public drinking water systems.
MSMCL[2] = Massachusetts Secondary Maximum Contaminant Level. (Massachusetts) Nonenforceable standard relating to aesthetic qualities and public acceptance of drinking water.
ORSG[2] = Office of Research and Standards Guideline. (Massachusetts) A nonenforceable health based guideline for drinking water quality.
[1]"Drinking Water Regulations and Health Advisories", December 1993, USEPA Office of Water
[2]"Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Waters", Spring 1993, Massachusetts Department of Environmental Protection

TABLE 3–4

COMPARISON OF PRELIMINARY REMEDIAL GOALS FOR COLD SPRING BROOK POND SEDIMENTS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ANALYTE	MAXIMUM SITE CONCENTRATION	AVERAGE SITE CONCENTRATION	OME LOWEST EFFECT LEVEL[1]	OME SEVERE EFFECTS LEVEL[1]	NOAA EFFECTS RANGE LOW[2]	NOAA EFFECTS RANGE MEDIAN[2]
INORGANICS ($\mu g/g$)						
Arsenic	390	78	6	33	33	85
Lead	570	70	31	250	35	110

Notes:

1. Ontario Ministry of the Environment (OME) Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (Persaud et. al., 1992
2. The Potential for the Biological Effects of Sediment–Sorbed Contaminants Tested in the National Status and Trends Program (NOAA, 1990).

TABLE 3-5
REMEDIAL ACTION OBJECTIVES

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

COLD SPRING BROOK LANDFILL GROUNDWATER	
•	Prevent future residential exposure to groundwater exceeding the following concentrations: aluminum (6,870 μg/L), arsenic (50 μg/L), iron (9,100 μg/L), manganese (291 μg/L), sodium (20,000 μg/L), and bis(2-ethylhexyl)phthalate (6 μg/L).
COLD SPRING BROOK POND SEDIMENT	
•	Prevent ecological exposure to hot spot concentrations of arsenic and lead at Sediment Areas I and II.
•	Minimize alteration and potential impacts to Cold Spring Brook Pond and associated wetland.
•	Meet location-specific and action-specific ARARs.

Table 3-6
Potential Remedial Technologies and Process Options for Groundwater

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

General Response Action	Remedial Technology	Process Option
No Action	None	Not Applicable
Limited Action	Institutional Controls	Zoning Restrictions
		Deed Restrictions
	Environmental Monitoring	Groundwater Monitoring
Containment	Hydraulic Barriers	Slurry Wall
		Sheet Piling
Collection	Extraction	Interceptor Trenches
		Extraction Wells
Treatment	Physical/Chemical	Aeration (Precipitation)
		Filtration
		Chemical Precipitation
		Air Stripping
		UV Oxidation
		Activated Carbon
		Ion Exchange
		Fixation (In situ)
		Air Sparging (In situ)*
		Electrolytic Sep. (In situ)*
	Biological	Constructed Wetland
		Bioremediation (In situ)*
		Fort Devens WWTP
		Ayer POTW
Discharge	On Site	Fort Devens WWTP
		To Groundwater
	Off Site	Ayer POTW

Notes:

* Innovative technology listed in USEPA VISITT Database.
WWTP = wastewater treatment plant
POTW = publicly owned treatment works
USEPA = U.S. Environmental Protection Agency

TABLE 3-7
POTENTIAL REMEDIAL TECHNOLOGIES
AND PROCESS OPTIONS FOR SOURCE AREA SOILS/SOLID WASTES

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION
No Action	None	Not Applicable
Containment	Cover	Soil Cover
		Low Permeability Cover
Removal	Excavation	Excavation
	Removal	Drum Removal
Disposal	On Site	Landfilling
	Off Site	RCRA TSD Facility

Notes:

RCRA = Resource Conservation and Recovery Act
TSD = treatment, storage, and disposal

TABLE 3-8
POTENTIAL REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS FOR SEDIMENT

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION
No Action	None	Not Applicable
Limited Action	Institutional Controls	Fencing/Signs
		Zoning Restrictions
	Environmental Monitoring	Sediment Monitoring
		Bio-Monitoring
Containment	Cover	Soil Cover (In situ)
		Low Perm. Cover (In situ)
Removal	Wet Dredging	Clamshell Dredge
		Hydraulic Dredge
	Dry Excavation	Tracked Equipment
Treatment	Physical/Chemical	Incineration
		Solidification
		Stabilization
		Thermal Desorption*
		Solvent Extraction*
		Soil Washing*
	In situ Treatment	Vitrification* (In situ)
		Stabilization* (In situ)
		Solidification (In situ)
Disposal	On Site	Landfilling
	Off Site	RCRA TSD Facility

Notes:

* Innovative technology listed in USEPA VISITT Database.
RCRA = Resource Conservation and Recovery Act
TSD = treatment, storage, and disposal
USEPA = U.S. Environmental Protection Agency

TABLE 3-9
DESCRIPTION OF GROUNDWATER PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
No Action	
None	No action taken to reduce risk.
Limited Action	
Institutional Controls	Zoning Restrictions. Through administrative controls, zone land around Cold Spring Brook Landfill to prohibit residential development. Deed Restrictions. Place deed restrictions on transferred land to prohibit future installation of drinking water wells.
Environmental Monitoring	Groundwater Monitoring. Perform water quality analyses to monitor contaminant concentrations and assess future environmental impacts.
Containment	
Hydraulic Barriers	Slurry Wall. Excavate a trench in overburden and fill with impervious backfill to provide a low-permeability cutoff wall. Sheet Piling. Drive steel sheet piles into the overburden to provide a low-permeability cutoff wall.
Collection	
Extraction	Interceptor Trenches. Trenches, drains, and piping used to passively collect (by gravity flow) groundwater. Trench installation is typically limited to a depth of approximately 40 feet, and cannot be used below the bedrock surface. Extraction Wells. Install extraction wells to collect groundwater. Wells are typically installed using augers in unconsolidated soils, and coring for bedrock wells. Wells are usually completed by placing a well screen to the desired depth and placing sandpack between well screen and aquifer materials. Well screens are chosen based on the characteristics of the aquifer material in which the well is placed.

continued

TABLE 3-9
DESCRIPTION OF GROUNDWATER PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
Treatment	
Physical/Chemical	Aeration (Precipitation). Aerate the extracted groundwater to oxidize and precipitate inorganic compounds (i.e., arsenic and iron). Precipitated compounds are removed by settling in a clarifier and/or filtration.
	Filtration. Use of a filter to remove total suspended solids and precipitated floc.
	Chemical Precipitation. Chemical precipitation removes dissolved metals from aqueous wastes by chemically converting the metals to an insoluble form. The process produces a metal precipitate sludge and a treated effluent. The insoluble precipitate is typically removed by settling in a clarifier and/or filtration.
	The most common precipitation processes are hydroxide, carbonate, and sulfide precipitation, and potassium permanganate oxidation/precipitation. Flocculation agents can be added to precipitation processes to encourage small suspended particles to agglomerate into larger particles that settle faster.
	Air Stripping. Air stripping removes VOCs from extracted groundwater by contacting contaminated water with large volumes of air. Contaminants are transferred from the liquid phase to the gas phase, and carried off with effluent air.
	UV Oxidation. UV oxidation involves the simultaneous application of UV radiation and chemical oxidants to degrade low concentrations of aqueous organics. Ozone and hydrogen peroxide have been documented as chemical oxidants.
	Activated Carbon. Activated carbon adsorption is a physical separation process in which organic and inorganic materials are removed from wastewater by sorption (i.e., the attraction and accumulation of one substance on another). Contaminants are removed by sorption onto available granular-activated carbon sites.
	Ion Exchange. Metal ions are removed from solution by exchange with ions electrostatically attached to a solid resin material.

continued

TABLE 3-9
DESCRIPTION OF GROUNDWATER PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
	Fixation (In situ). Injection of chemicals into the groundwater to change the redox potential and render contaminants immobile.
	Air Sparging (In situ). In situ air sparging removes VOCs from groundwater by forcing air into the saturated zone. Contaminants dissolved in the groundwater volatilize into the air stream, and are transported to the vadose zone where they can be collected by a soil vapor extraction system.
	Electrolytic Separation (In situ). A DC electric field is imposed across electrode pairs placed in the ground. Metal ions migrate toward the cathode where they concentrate. The concentrated solution of contaminants is removed with groundwater from extraction wells.
Biological	Constructed Wetland. Passive flow of contaminated groundwater through a constructed wetland. Inorganics can be removed from the groundwater by several natural wetland processes including filtration and uptake by plant roots, adsorption of contaminants onto inorganic soil, neutralization and precipitation of contaminants.
	Bioremediation (In situ). Introduces microorganisms, nutrients, and oxygen into the groundwater using a matrix of injection wells and recirculation techniques.
	Destroys organics through biodegradation, acclimation, degradation, or chemical conversion of organic wastes by either aerobic or anaerobic biological treatment processes.
	Fort Devens WWTP. Transport untreated groundwater to Fort Devens WWTP for treatment. This plant is a primary wastewater treatment facility located on North Post.
	Ayer POTW. Transport untreated groundwater to Ayer POTW for Treatment. This plant is an activated sludge facility.

continued

TABLE 3-9
DESCRIPTION OF GROUNDWATER PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
Discharge	
On Site	Fort Devens WWTP. Transport treated groundwater to Fort Devens WWTP.
	To Groundwater. Reinject treated groundwater meeting Massachusetts discharge limits outside limits of contamination.
Off Site	Ayer POTW. Transport treated groundwater to Ayer POTW.

Notes:

VOCs	=	volatile organic compounds
UV	=	ultraviolet
WWTP	=	waste water treatment plant
POTW	=	publicly-owned treatment works

Table 3-10
Description of Source Area Soils/Solid Wastes process Options

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

General Response Action/Technology	Description of Process Options
No Action	
None	No action taken to reduce exposure to Cold Spring Brook Landfill soils and solid wastes.
Containment	
Cover	Soil Cover. Place clean soil over area of concern to reduce exposure to contaminated surface soil.
	Low-Permeability Cover. Place a low-permeability material (e.g., clay, asphalt, synthetic membrane) over Cold Spring Brook Landfill to reduce exposure to soil and precipitation infiltration.
Removal	
Excavation	Excavation. Remove contamination source by excavating Cold Spring Brook Landfill.
Removal	Drum Removal. Removal and proper disposal of abandoned 55-gallon drums along the edge of Cold Spring Brook Pond.
Disposal	
On Site	Landfilling. Disposal of nonhazardous excavated soils and solid wastes from Cold Spring Brook Landfill on site.
Off Site	RCRA TSD Facility. Transport materials of concern to an off-site permitted RCRA facility.

Notes:

RCRA = Resource Conservation and Recovery Act
TSD = treatment, storage and disposal

TABLE 3-11
DESCRIPTION OF SEDIMENT PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
No Action	
None	No action taken to reduce exposure to pond sediments.
Limited Action	
Institutional Controls	Fencing/Signs. Restrict site access with chain-link fencing. Post warning signs.
	Zoning Restrictions. Through administrative controls, zone land around Cold Spring Brook Landfill to prevent residential development.
Environmental Monitoring	Sediment Monitoring. Collect periodic samples of pond sediments to identify increasing or decreasing risks.
	Bio-Monitoring. Collect periodic samples of pond biota to identify increasing or decreasing risks.
Containment	
Cover	Soil Cover (In situ). Cover contaminated pond sediments with a layer of soil/sand/peat.
	Low-Permeability Cover (In situ). Cover contaminated pond sediments with a low-permeability layer of clay or bentonite.
Removal	
Wet Dredging	Clamshell Dredge. Contaminated pond sediments would be excavated by a mechanical dredge either located on shore or mounted on a floating barge.
	Hydraulic Dredge. Contaminated pond sediment would be excavated by a hydraulic dredge mounted on a floating barge.
Dry Excavation	Tracked Equipment. Pond water would be drained, if necessary, and contaminated sediments would be removed by conventional excavation equipment.
Treatment	
Physical/Chemical	Incineration. Excavated sediments would be transported to an off-site facility for thermal destruction of contaminants.
	Solidification. A settling agent would be mixed with sediment to form a solid mass of low solubility, and in which contaminants are trapped.
	Stabilization. Chemical stabilization involves the addition of chemicals to the sediment to maintain the wastes in their least toxic or mobile form, and may or may not cause a change in the physical characteristics of the wastes.

continued

TABLE 3-11
DESCRIPTION OF SEDIMENT PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/TECHNOLOGY	DESCRIPTION OF PROCESS OPTIONS
	Thermal Desorption. Thermal desorption uses indirect or direct heat exchange to vaporize organic contaminants including VOCs, some SVOCs and PCBs from soil or sludge.
	Solvent Extraction. Contaminants extracted from soil/sediment using water or other solvents. Solvent(s) containing the concentrated contaminants requires additional treatment to recover the solvent(s) for reuse and to treat/dispose of the contaminants.
	Soil Washing. Contaminated soil/sediments are separated from clean soils by a washing process. The washing solution may be composed of water, organic solvents, water/chelating agents, water/surfactants, acids or bases. Clean soil may be returned to site. Concentrated contaminated material is treated further or disposed.
In situ Treatment	
	Vitrification (In situ). High temperature created by electric current is used to reduce organic compounds to carbon dioxide, hydrogen and carbon. Inorganic contaminants become entrained in glass and silicous materials.
	Stabilization (In situ). Stabilization reagents are injected directly into contaminated sediments.
	Solidification (In situ). A setting agent would be mixed with contaminated sediment to form a solid mass of low solubility in water, and in which contaminants are entrapped.
Disposal	
On Site	Landfilling. Disposal of treated nonhazardous sediments on site.
Off Site	RCRA TSD Facility. Transport materials of concern to an off-site permitted RCRA facility.

Notes:

VOCs	=	volatile organic compounds
SVOCs	=	semivolatile organic compounds
PCBs	=	polychlorinated biphenyls
RCRA	=	Resource Conservation and Recovery Act
TSD	=	treatment, storage and disposal

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO: SITE-LIMITING CHARACTERISTICS	APPLICABILITY TO: WASTE-LIMITING CHARACTERISTICS	SCREENING STATUS	COMMENTS
No Action				
None	None Easily implementable	None.	Retained.	Required for consideration by NCP. Does not achieve remedial action objectives.
Limited Action				
Zoning Restrictions	Can only be implemented on property transferred by the Army. Would prohibit residential development within restricted area.	None. Prevents future residential development.	Retained.	Retained for implementation on Army Property.
Deed Restrictions	Can only be implemented on property transferred by the Army. Would prohibit installation of residential wells within restricted area.	None. Prevents future residential ingestion of groundwater.	Retained.	Retained for implementation on Army Property.
Groundwater Monitoring	None. Easily implementable. Groundwater monitoring wells currently exist on site and may be used in a groundwater monitoring program.	None. Would enable assessment of changes in contaminant concentrations over time.	Retained.	Would be considered in conjunction with other technologies.

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Containment				
Slurry Wall	Hydraulic barrier could have potential major adverse effect on Cold Spring Brook Pond. Also would not prevent high background/upgradient concentrations of chemicals from reaching Patton Well.	Barrier design would require consideration of groundwater contaminants that may degrade barrier over time. May reduce mobility of chemicals in groundwater. Could be used in conjunction with collection and treatment/disposal technologies to meet response objectives.	Eliminated.	Slurry wall would reduce groundwater discharge to pond with potential adverse effect on water quality and pond ecology. Also could affect groundwater flow to Patton Well with unknown effects on well water quality.
Sheet Piling	Implementable. Compared to slurry wall, less controlled installation, less likely to achieve low permeability seal due to poor connections between the steel sheets.	Similar effectiveness as slurry wall.	Eliminated.	Inappropriate for deep overburden.
Collection				
Interceptor Trenches	Not Implementable. Lack of topographic relief and shallow groundwater gradient at site would limit effectiveness. Fine sands may create construction difficulties.	Effective technology to passively collect contaminated groundwater. Can prevent migration of contaminated groundwater.	Eliminated.	

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Extraction Wells	Use of extraction wells could affect groundwater at Patton Well. Commonly used technology. Produces very little contaminated soil requiring disposal.	None. Effective mechanism to collect contaminated groundwater. Can prevent migration of contaminated groundwater.	Eliminated.	Groundwater extraction would reduce groundwater discharge to Cold Spring Brook Pond with potential adverse effect on water quality and pond ecology. Also could affect ground-water flow toward Patton Well with unknown effects on well water quality.
<u>Treatment</u> Aeration	Requires groundwater extraction. Easily implementable for extracted groundwater. Precipitated sludge may require disposal at a RCRA TSD facility.	Effective method for oxidation and precipitation of arsenic and iron. Requires chemical oxidant to be effective for manganese. Groundwater may require additional treatment to achieve Maximum Contaminant Levels (MCLs).	Eliminated.	Groundwater treatment technologies will not be considered unless groundwater conditions change substantially in the future.

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Filtration	Requires groundwater extraction.	None.	Eliminated	
	Easily implementable for extracted groundwater.	Effective for removal of total suspended solids and precipitated floc.		
	Filtered solids may require disposal at a RCRA TSD Facility			
Chemical Precipitation	Requires groundwater extraction.	None.	Eliminated.	
	Easily implementable for extracted groundwater.	Effective treatment for removing the groundwater contaminants As, Fe, and Mn. Precipitation may also remove low levels of a few organics in groundwater.		
	Precipitated heavy metal sludge would require treatment/disposal.	Groundwater may require additional treatment to achieve MCLs.		
Air Stripping	Requires groundwater extraction.	Does not provide effective treatment for inorganics.	Eliminated.	
	Easily implementable commonly used technology.			
UV Oxidation	Requires groundwater extraction. Commonly used technology. Self-contained and mobile units available.	Does not provide effective treatment for inorganics.	Eliminated.	

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO: SITE-LIMITING CHARACTERISTICS	APPLICABILITY TO: WASTE-LIMITING CHARACTERISTICS	SCREENING STATUS	COMMENTS
Activated Carbon	Requires groundwater extraction.	Primarily a treatment for organic contaminants. Not proven effective for inorganics.	Eliminated.	
	Implementable. Commonly used technology. Self contained and mobile units available.			
	Waste carbon considerably more toxic than influent water, special disposal, regeneration or destruction is required.			
Ion Exchange	Requires groundwater extraction.	None.	Eliminated.	
	Implementable. Self-contained, mobile units available. High technical feasibility and demonstrated performance.	Effectively removes As, Mn, Fe and inorganics from groundwater.		
	Resin regeneration brine is considerably more toxic than influent water; special disposal or destruction is required.	Resins are often selective, and may be susceptible to fouling by high concentrations of TSS, and precipitated inorganics. Filtration prior to treatment may be required.		

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO: SITE-LIMITING CHARACTERISTICS	APPLICABILITY TO: WASTE-LIMITING CHARACTERISTICS	SCREENING STATUS	COMMENTS
Fixation (In situ)	In-situ mixing of fixation chemical may be difficult. May have adverse impact on Patton Well.	None.	Eliminated.	
	Wells may become plugged by precipitation of minerals caused by chemical reactions of soil/aquifer constituents with injected nutrients.	Hydrogen Peroxide has been shown to effectively oxidize Fe. As has been shown to co-precipitate with Fe.		
	Does not require groundwater extraction.			
Air Sparging (In situ)	Does not require groundwater extraction.	Not effective treatment for inorganics.	Eliminated.	
Electrolytic Separation (In situ)	Large power requirements.	Has been demonstrated effective for removal of ionized inorganics at bench scale. Innovative technology. Not proven at full scale.	Eliminated.	
	Does not require groundwater extraction			

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Constructed Wetland	Requires groundwater extraction. Low maintenance. Large spatial requirements to ensure low flow rates, and minimal depth of water in wetland.	Natural and constructed wetlands have been proven effective at removing some inorganics (i.e., Fe, Mn) from groundwater through natural processes. Effectiveness for removal of arsenic is not proven. Inorganics would be concentrated in wetland soil and organic material.	Eliminated.	
Bio-remediation (In situ)	May have adverse impact on Patton Well. Wells may become plugged by precipitation of minerals caused by chemical reactions of soil/aquifer constituents with injected nutrients.	Biological treatment will not remove arsenic or manganese.	Eliminated.	
Fort Devens WWTP	Would require piping groundwater to existing Fort Devens sewer system. Requires groundwater extraction.	Fort Devens has a <u>primary</u> waste water treatment facility, not designed to treat inorganics. Dilute groundwater not desirable at WWTP.	Eliminated.	

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO: SITE-LIMITING CHARACTERISTICS	APPLICABILITY TO: WASTE-LIMITING CHARACTERISTICS	SCREENING STATUS	COMMENTS
Ayer POTW	Would require piping groundwater to Ayer sewer system. Requires groundwater extraction. Ayer POTW does not usually accept contract wastes.	Dilute groundwater undesirable at WWTP.	Eliminated.	
Discharge				
Fort Devens WWTP	Would require piping groundwater to existing Fort Devens sewer system. Requires groundwater extraction.	Dilute groundwater undesirable at WWTP.	Eliminated.	Discharge technologies will not be considered unless groundwater conditions change substantially in the future.
To Groundwater	Requires groundwater extraction. Limited by recharge/ permeability rates of soils and availability of suitable nearby discharge site.		Eliminated.	

continued

TABLE 3-12
SCREENING OF GROUNDWATER TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Ayer POTW	Requires groundwater extraction. Would require piping groundwater to Ayer sewer system. Ayer POTW does not usually accept contract wastes.	Dilute groundwater undesirable at WWTP.	Eliminated.	

Notes:

NCP	=	National Contingency Plan
MCLs	=	maximum contaminant levels
As	=	Arsenic
Mn	=	Manganese
Fe	=	Iron
TDS	=	total dissolved solids
WWTP	=	waste water treatment plant
POTW	=	publicly owned treatment works
BOD	=	biological oxygen demand
NPDES	=	National Pollutant Discharge Elimination System
RCRA	=	Resource Conservation and Recovery Act
TSD	=	treatment, storage and disposal
UV	=	ultraviolet
TSS	=	total suspended solids
bgs	=	below ground surface

TABLE 3-13
SCREENING OF SOURCE AREA SOILS/SOLID WASTE TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
<u>No Action</u>				
None	None Easily implementable.	Does not mitigate leaching of contaminants to Cold Spring Brook Pond or groundwater.	Retained.	Required for consideration by NCP.
<u>Limited Action</u>				
Fencing/Signs	None. Implementable.	Does not mitigate leaching of contaminants to Cold Spring Brook Pond or groundwater.	Retained.	
Zoning Restrictions	Can only be implemented on property transferred by the Army. Would prohibit residential development within the restricted area.	Does not mitigate leaching of contaminants to Cold Spring Brook Pond or Groundwater.	Retained.	
Groundwater Monitoring	None. Wells that could be used for monitoring are currently located on site.	Does not mitigate leaching of contaminants to Cold Spring Brook Pond or Groundwater. Would provide data to assess future contamination.	Retained.	

continued

TABLE 3-13
SCREENING OF SOURCE AREA SOILS/SOLID WASTE TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Containment				
Soil Cover	Wetland permits may be required for construction activities within Cold Spring Brook Pond. Implementable. Common technology.	Effectively reduces direct contact exposure, but would not reduce potential leaching of contaminants to Cold Spring Brook Pond sediments and groundwater.	Eliminated.	
Low-Permeability Cover	Wetland permits may be required for construction activities within Cold Spring Brook Pond. Implementable. Common technology.	None. Effectively reduces precipitation infiltration to wastes, thereby reducing leachate migration to groundwater. Reduces direct contact exposure.	Retained.	

continued

TABLE 3-13
SCREENING OF SOURCE AREA SOILS/SOLID WASTE TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Removal				
Excavation	Access to some portions of site may be difficult due to steep terrain. Wetland permits may be required for construction activities within Cold Spring Brook Pond.	Effectively removes source of contamination. Excavation of heterogeneous waste may be difficult.	Retained.	Could be used extensively or for hot spots only.
Drum Removal	None	None	Retained	
Disposal				
Landfilling	Space requirements on site must be considered. Must comply with Massachusetts solid waste regulations.	Must comply with Land Disposal Restrictions.	Retained.	

continued

TABLE 3-13
SCREENING OF SOURCE AREA SOILS/SOLID WASTE TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
RCRA TSD Facility	Limited number of facilities already operating at maximum capacity.	Must comply with Land Disposal Restrictions. RCRA facilities provide secure disposal.	Retained.	Only retained in the event that any wastes excavated from the Cold Spring Brook Landfill or Pond fail a TCLP test.

Notes:

NCP = National Contingency Plan
RCRA = Resource Conservation and Recovery Act
TSD = treatment, storage, and disposal
TCLP = Toxicity Characteristic Leachate Procedure

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
No Action				
None	None	Does not reduce toxicity, mobility, or volume of contaminants in sediment.	Retained.	Required for consideration by NCP. Does not meet remedial response objectives.
Limited Action				
Fencing/Signs	None. Easily implementable.	None. Would not prevent ecological exposure to contaminated sediments. Would not reduce toxicity, mobility, or volume of contaminants in sediment.	Retained.	
Zoning Restrictions	Can only be implemented on property transferred by the Army. Would prohibit residential development within restricted area. Easily implementable at Cold Spring Brook Landfill.	None.	Retained.	

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continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Sediment Monitoring	None.	None. Would identify increasing or decreasing risks by continued sediment sampling.	Retained.	
Bio-Monitoring	None.	None. Would identify increasing or decreasing risks by continued sampling of invertebrates inhabiting Cold Spring Brook Pond sediment.	Retained.	

continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Containment				
Soil Cover (In situ)	Pond vegetation may cause difficulty placing a soil barrier. Installation of soil cover would alter pond habitat.	Flow currents in pond, activity of benthic organisms, or foraging animals could reexpose As in contaminated sediments. By providing a soil barrier, would prevent human and ecological exposure to As in sediment.	Eliminated.	
Low-Permeability Cover (In situ)	Pond vegetation may cause difficulty placing a soil barrier. Installation of cover would alter pond habitat.	Flow currents in pond, activity of benthic organisms, or foraging animals could reexpose As in contaminated sediments. By providing a soil barrier, would prevent human and ecological exposure to As in sediment.	Eliminated.	

continued

Table 3-14
Screening of Sediment Technologies and Process Options

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

General Response Action/ Process Option	Applicability to: Site-Limiting Characteristics	Applicability to: Waste-Limiting Characteristics	Screening Status	Comments
Removal				
Clamshell Dredge	Implementable. Limited reach for unit on shore. Minimum water depth required for floating unit. Mechanical dredges provide precision dredging and high percentage of solids recovery. Would alter pond habitat.	Clamshells create resuspension of sediments and are not watertight. This could redistribute contaminants.	Retained.	Good for hot spot dredging.
Hydraulic Dredge	Implementable. Many types of hydraulic dredges available to meet site requirements, and provide precision dredging.	None. Would effectively remove contaminated sediments. Low rate of resuspension, less redistribution of contaminants.	Retained.	

continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
	Minimum water depth required for floating unit. Would alter pond habitat. Would require dewatering and treatment of supernatant prior to discharge. Would require handling of solids, and TCLP testing prior to disposal.			Good if dredging entire pond.
Tracked Equipment	Ability of pond bottom to support tracked equipment is uncertain. Would alter pond habitat. Would require surface water diversion. Would require dewatering of sediment and TCLP testing and handling of supernatant and solids.	Would effectively remove contaminated sediments. Would adversely affect benthic organisms.	Eliminated.	

continued

Table 3-14
Screening of Sediment Technologies and Process Options

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

General Response Action/ Process Option	Applicability to		Screening Status	Comments
	Site-Limiting Characteristics	Waste-Limiting Characteristics		
Treatment				
Incineration	Easily implementable, off-site facilities on-line. Capacity limitations and permit requirements must be considered.	Not an effective treatment for inorganics which are the primary contaminants.	Eliminated.	
Stabilization	Implementable for excavated sediments.	None. Demonstrated effective for the treatment of metals.	Retained.	Retained for potential use prior to on-site landfilling.
Solidification	Treatability Study may be necessary to obtain the appropriate mix of cement and additives to effectively bind the contaminants.	Organic matter in sediment may interfere with ability to solidify sediment.	Eliminated	Solidified material would still require secondary containment, therefore little or no advantage over stabilization.
Thermal Desorption	Need to assess availability of utilities.	Generally not effective treatment for metals. Less effective for high moisture content material.	Eliminated.	

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continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
Solvent Extraction	None. Implementable. Technology demonstrated at hazardous waste sites.	Not effective treatment for the removal of metals. If solvents are toxic, sediment may require treatment after extraction to remove residual solvent. Treatability tests may be required.	Eliminated.	
Soil Washing	None. Implementable. Technology demonstrated and commercially available. Requires treatment/ disposed of residuals.	High humic content can make separation of contaminants very difficult (Wastech, 1993).	Eliminated.	Peaty nature of sediment and TOC values of up to 50 percent could limit effectiveness.
Vitrification (In situ)	Technology not implementable under water.	Not an effective treatment for wastes with a moisture content greater than 25%.	Eliminated.	

continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO: SITE-LIMITING CHARACTERISTICS	APPLICABILITY TO: WASTE-LIMITING CHARACTERISTICS	SCREENING STATUS	COMMENTS
Stabilization (In situ)	May be more difficult to mix sediment and stabilizing reagents in situ. Would adversely affect benthic organisms.	May be less effective treatment than ex situ due to potentially less homogenous mixture of sediment and stabilizing reagents.	Eliminated.	
Solidification (In situ)	May be more difficult to mix sediments and solidifying reagents in situ. Would adversely affect benthic organisms.	May be less effective treatment than ex situ due to potentially less homogeneous mixture of sediment and solidifying reagents.	Eliminated.	
Disposal				
Landfilling	Space requirements on site must be evaluated.	Dewatered, treated sediments must pass TCLP. Must comply with Land Disposal Restrictions. Supernatant from dewatered dredge spoil may require treatment prior to discharge.	Retained.	Dredge spoil must be disposed of.
RCRA TSD Facility	Implementable.	RCRA facilities provide secure disposal.	Retained.	

continued

TABLE 3-14
SCREENING OF SEDIMENT TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/ PROCESS OPTION	APPLICABILITY TO		SCREENING STATUS	COMMENTS
	SITE-LIMITING CHARACTERISTICS	WASTE-LIMITING CHARACTERISTICS		
	Limited number of facilities already operating at maximum capacity.	Must comply with Land Disposal Restrictions. Supernatant from dewatered dredge spoil may require treatment prior to discharge.		

Notes:

NCP	=	National Contingency Plan
As	=	Arsenic
TCLP	=	Toxicity Characteristic Leachate Procedure
RCRA	=	Resource Conservation and Recovery Act
TSD	=	treatment, storage, and disposal

TABLE 3-15
SCREENING SUMMARY OF TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/PROCESS OPTION	RETAINED	ELIMINATED
GROUNDWATER		
No Action		
None	X	
Limited Action		
Zoning Restrictions	X	
Deed Restrictions	X	
Groundwater Monitoring	X	
Containment		
Slurry Wall		X
Sheet Piling		X
Collection		
Interceptor Trench		X
Extraction Wells		X
Treatment		
Aeration		X
Filtration		X
Chemical Precipitation		X
Air Stripping		X
UV Oxidation		X
Activated Carbon		X
Ion Exchange		X
Fixation (In situ)		X
Air Sparging (In situ)		X
Electrolytic Separation (In situ)		X
Constructed Wetland		X
Bioremediation (In situ)		X
Fort Devens WWTP		X
Ayer POTW		X

continued

TABLE 3-15
SCREENING SUMMARY OF TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/PROCESS OPTION	RETAINED	ELIMINATED
Discharge		
Fort Devens WWTP		X
Groundwater		X
Ayer POTW		X
SOURCE AREA SOILS/SOLID WASTES		
No Action		
None	X	
Limited Action		
Fencing/Signs	X	
Zoning Restrictions	X	
Groundwater Monitoring	X	
Containment		
Soil Cover		X
Low Permeability	X	
Removal		
Excavation	X	
Drum Removal	X	
Disposal		
Landfilling	X	
RCRA TSD Facility	X	
SEDIMENT		
No Action		
None	X	
Limited Action		
Fencing/Signs	X	
Zoning Restrictions	X	
Sediment Monitoring	X	
Bio-Monitoring	X	
Containment		
Soil Cover (In situ)		X
Low-Permeability Cover (In situ)		X

continued

TABLE 3-15
SCREENING SUMMARY OF TECHNOLOGIES AND PROCESS OPTIONS

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

GENERAL RESPONSE ACTION/PROCESS OPTION	RETAINED	ELIMINATED
Removal		
Clamshell Dredge	X	
Hydraulic Dredge	X	
Tracked Equipment		X
Treatment		
Incineration		X
Stabilization	X	
Solidification		X
Thermal Desorption		X
Solvent Extraction		X
Soil Washing		X
Vitrification (In situ)		X
Stabilization (In situ)		X
Solidification (In situ)		X
Disposal		
Landfilling	X	
RCRA TSD Facility	X	

Notes:

UV = ultraviolet
WWTP = wastewater treatment plant
POTW = publicly owned treatment works
RCRA = Resource Conservation and Recovery Act
TSD = treatment, storage and disposal

TABLE 4-1
ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

This alternative includes implementation of zoning and deed restrictions, installation of a fence and warning signs, drum and hot spot sediment removal, long-term monitoring of groundwater, sediments, and biota, and five-year site reviews.

EFFECTIVENESS	IMPLEMENTABILITY	COST
Advantages	Advantages	Advantages
• Should reduce toxicity, mobility, and volume of contaminants in sediments by hot spot removal.	• Zoning, fencing, sediment removal and environmental monitoring are implementable technologies.	• Moderate capital and O&M costs for sediment removal, long-term groundwater, sediment and bio-monitoring and five-year site reviews.
• Fences and warning signs would reduce potential for human exposure.	• Hot spot sediment removal would minimally impact wetland area.	
• Zoning and land use restrictions would reduce potential for public health exposure.		
• Should meet remedial action objectives.		
Disadvantages	Disadvantages	Disadvantages
• CSBL would not be removed; therefore potential for future release exists.	• Future remedial actions at the landfill and pond may be necessary if future releases from landfill occur.	• Potential for future remedial action costs.
• Potential for short-term worker exposure during sediment removal.		
• Activity in Cold Spring Brook Pond may cause adverse ecological effects.		

ESTIMATED CAPITAL COST $1,518,000
ESTIMATED PRESENT WORTH OF O&M COSTS $462,000
ESTIMATED TOTAL PRESENT WORTH $1,980,000

CONCLUSION: This alternative will be retained. Alternative CSBL-2 should meet remedial action objectives with minimal impact to Cold Spring Brook Pond and wetland area. ARARs will be attained under this alternative.

Notes:

O&M = operations and maintenance
CSBL = Cold Spring Brook Landfill

Table 4-2
Alternative CSBL-3: Landfill Capping/Drum and Hot Spot Sediment Removal

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Alternative CSBL-3 is a containment option that includes placing a low-permeability cap over the Cold Spring Brook Landfill to reduce potential future releases to groundwater and sediment, and drum and hot spot sediment removal. Components from Alternative CSBL-2 are included.

EFFECTIVENESS	IMPLEMENTABILITY	COST
Advantages	Advantages	Advantages
• Should reduce toxicity, mobility, and volume of contaminants in sediments by hot spot removal.	• Cap construction and sediment removal are well-developed, implementable technologies.	• Moderate O&M costs for long-term groundwater, sediment and bio-monitoring and five-year site reviews.
• Low-permeability cap would improve runoff and infiltration characteristics of landfill cover, minimizing potential future releases to groundwater and sediment.		
• Zoning and land use restrictions would reduce potential for public health exposure.		
• Should meet remedial action objectives.		
Disadvantages	Disadvantages	Disadvantages
• CSBL would not be removed; therefore potential for future release exists.	• Future remedial actions may be necessary if future releases from landfill occur.	• Potential for future remedial action costs.
• Potential for short-term worker exposure during cap construction and sediment removal.	• Cap construction activities would impact wetland area.	• High capital costs for landfill capping and sediment removal and disposal.
• Activity in Cold Spring Brook Pond may cause adverse short-term ecological effects.	• Access along toe of slope may be difficult due to wet conditions.	
	• Wetlands restoration would likely be required.	

ESTIMATED CAPITAL COST $2,956,000
ESTIMATED PRESENT WORTH OF O&M COSTS $512,000
ESTIMATED TOTAL PRESENT WORTH $3,468,000

CONCLUSION: This alternative will be retained because it should meet remedial action objectives; however, it will have a greater impact on Cold Spring Brook Pond and wetland area than Alternative CSBL-2. ARARs will be attained.

Notes:

O&M = operations and maintenance
CSBL = Cold Spring Brook Landfill

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TABLE 4-3
ALTERNATIVE CSBL 4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

Alternative CSBL-4 is a source removal option that includes excavation of the Cold Spring Brook Landfill and drum and hot spot sediment removal.

EFFECTIVENESS	IMPLEMENTABILITY	COST
Advantages	Advantages	Advantages
• Should reduce toxicity, mobility, and volume of contaminants in sediment by hot spot removal.	• Because wastes would be removed from the site, unlimited use of and exposure to site would be acceptable.	• Low potential for future remedial action costs.
• Excavation of CSBL would eliminate potential future releases to groundwater and sediment.	• Excavation and sediment removal are well developed, implementable technologies.	• Short-term environmental monitoring minimizes O&M costs.
• Meets remedial action objectives.	• Limited environmental monitoring required because contamination sources will be removed.	
Disadvantages	Disadvantages	Disadvantages
• Potential for short-term worker exposure during landfill excavation and sediment removal.	• Landfill excavation activities would impact the wetland.	• Very high capital costs for excavation of landfill waste, excavation of sediment and construction of a solid waste landfill for disposal of wastes.
• Activity in Cold Spring Brook Pond may cause adverse short-term ecological effects.	• Access along toe of slope may be difficult due to wet conditions.	
• Toxicity, mobility, and volume of landfill waste would not be reduced because waste is not treated, only transferred to another landfill.	• Wetlands restoration would be required.	

continued

TABLE 4-3
ALTERNATIVE CSBL 4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

EFFECTIVENESS	IMPLEMENTABILITY	COST
	• On-base location for construction of a solid waste landfill would have to be identified, and permit acquired.	

ESTIMATED CAPITAL COST (INCLUDING EXCAVATED WASTE DISPOSAL) $6,599,000
ESTIMATED PRESENT WORTH OF O&M COSTS $189,000
ESTIMATED TOTAL PRESENT WORTH $6,788,000

Conclusion: This alternative is a source control option that would remove the CSBL as a potential source of contamination to groundwater and sediment. It will be retained for further evaluation in the detailed analysis. Alternative CSBL-4 meets remedial action objectives, however, it will have a greater impact on Cold Spring Brook Pond and wetland area than Alternatives CSBL-2 and CSBL-3. ARARs will be attained.

Note:

O&M = operations and maintenance
CSBL = Cold Spring Brook Landfill

TABLE 4-4
SCREENING SUMMARY OF ALTERNATIVES

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

REMEDIAL ALTERNATIVES	RETAINED	ELIMINATED
Alternative CSBL-1: No Action	X	
Alternative CSBL-2: Drum Removal/Hot Spot Sediment Removal	X	
Alternative CSBL-3: Landfill Capping/Drum and Hot Spot Sediment Removal	X	
Alternative CSBL-4: Landfill Excavation/Drum and Hot Spot Sediment Removal	X	

TABLE 5-1
ALTERNATIVE EVALUATION CRITERIA

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

THRESHOLD CRITERIA (must be met by each alternative)

- OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT - Assesses how well an alternative, as a whole, achieves and maintains protection of human health and the environment.

- COMPLIANCE WITH ARARS - Assesses how the alternative complies with location-, chemical-, and action-specific ARARs, and whether a waiver is required or justified.

PRIMARY CRITERIA (basis of alternative evaluation)

- LONG-TERM EFFECTIVENESS AND PERMANENCE - Evaluates the effectiveness of the alternative in protecting human health and the environment after response objectives have been met. Includes consideration of the magnitude of residual risks and the adequacy and reliability of controls.

- REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT - Evaluates the effectiveness of treatment processes used to reduce toxicity, mobility, and volume of hazardous substances. This criterion considers the degree to which treatment is irreversible, and the type and quantity of residuals remaining after treatment.

- SHORT-TERM EFFECTIVENESS - Examines the effectiveness of the alternative in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. Considers the protection of the community, workers, and the environment during implementation of remedial actions.

- IMPLEMENTABILITY - Assesses the technical and administrative feasibility of an alternative and availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and extent of required coordination with other parties or agencies.

- COST - Evaluates the capital and operation and maintenance cost of each alternative.

BALANCING CRITERIA

- STATE ACCEPTANCE - This criterion considers the state's preferences among or concerns about alternatives.

- COMMUNITY ACCEPTANCE - This criterion considers the communities preferences among or concerns about alternatives.

TABLE 5-2
LONG-TERM GROUNDWATER MONITORING PROGRAM

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

MONITORING WELL LOCATIONS	MONITORING PARAMETERS
	General Parameters
CSB-1	pH (measured in field)
CSB-2	Temperature (measured in field)
CSB-3	Specific Conductance (measured in field)
CSM-93-02A	Total Dissolved Solids
CSM-93-02B	Total Suspended Solids
	Total Organic Carbon
CSM-95-01	Alkalinity
CSM-95-02	Hardness
	Semivolatile Organic Compounds
	Compounds included in USEPA Method 8270
	Anions
	Chloride
	Sulfate
	Nitrate/Nitrite
	Inorganics
	Arsenic
	Barium
	Cadmium
	Chromium
	Copper
	Iron
	Lead
	Manganese
	Mercury
	Selenium
	Silver
	Zinc
	Cyanide

TABLE 5-3
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-1

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority		No location-specific ARARs will be triggered.			
State Regulatory Authority		No location-specific ARARs will be triggered.			

(continued)

TABLE 5-3
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-1

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority	Groundwater	SDWA, National Primary Drinking Water Standards, MCLs [40 CFR Parts 141.11 - 141.16 and 141.50 - 141.53]	Relevant and Appropriate	The NPDWR establishes MCLs and MCLGs for several common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health goals.	The MCL for bis(2-ethylhexyl)-phthalate will be met under average conditions and the MCL for arsenic will be met under average and maximum conditions. MCLs are not exceeded at Patton Well.
State Regulatory Authority		No chemical-specific ARARs will be triggered.			

(continued)

TABLE 5-3
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-1

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority		No action-specific ARARs will be triggered.			
State Regulatory Authority	Solid waste landfill construction, operation, closure, and post-closure care.	Massachusetts Solid Waste Management Regulations [310 CMR 19.100]	Relevant and Appropriate	These regulations outline the requirements for construction, operation, closure, and post closure at solid waste management facilities in the Commonwealth of Massachusetts.	The proposed groundwater monitoring program meets the requirements of 310 CMR 19.118 and 19.132.

TABLE 5–4
ALTERNATIVE CSBL–1: COST SUMMARY TABLE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ITEM	COST
DIRECT COSTS	
Monitoring wells	$11,000
TOTAL DIRECT COST	$11,000
INDIRECT COSTS	
Health and safety @ 5% of total direct cost	$0
Legal, Administrative, Permitting @ 5% of total direct cost	$0
Engineering @ 10% of total direct cost	$1,000
Services during construction @ 10% of total direct cost	$1,000
TOTAL INDIRECT COST	$2,000
TOTAL CAPITAL (DIRECT AND INDIRECT) COST	$13,000
OPERATION AND MAINTENANCE COSTS	
Total annual operating and maintenance costs for 30–year activities	$30,000
Total present worth of O&M costs @ 7% for 30 years	$372,000
TOTAL PRESENT WORTH OF O&M COSTS	$372,000
TOTAL PRESENT WORTH OF ALTERNATIVE	$385,000

P:TCLARK\CSB\COST–TAB.wk1

TABLE 5-5
LONG-TERM SEDIMENT MONITORING PROGRAM

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

MONITORING LOCATIONS	MONITORING PARAMETERS
Sed 1	Inorganics
Sed 2	Arsenic
Sed 3	Barium
Sed 4	Cadmium
	Chromium
	Copper
	Lead
	Mercury
	Selenium
	Silver
	Zinc
	Cyanide

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority	Floodplains	Floodplain Management Executive Order No. 11988 [40 CFR Part 6, App. A]	Applicable	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/ construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	If no practicable alternative exists, drum removal and hot-spot sediment dredging will be designed to minimize alteration/ destruction of floodplain area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.
	Wetlands	Protection of Wetlands Executive Order No. 11990 [40 CFR Part 6, App. A]	Applicable	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas, and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.	If no practicable alternative exists, drum removal and hot-spot sediment dredging will be designed to minimize alteration/ destruction of wetland area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.

continued

Table 5-6
Synopsis of Federal and State ARARs for Alternative CSBL-2

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
	Wetlands Aquatic Ecosystem	CWA, Dredge or Fill Requirements Section 404 [33 CFR Part 230; 40 CFR Part 230]	Applicable	Section 404 of the CWA regulates the discharge of dredged or fill materials to U.S. waters, including wetlands. Filling wetlands would be considered a discharge of fill materials. Procedures for complying with regulatory conditions are contained in 33 CFR Part 323. Guidelines for Specification of Disposal Sites for Dredged or Fill material at 40 CFR Part 230, promulgated under CWA Section 404(b)(1), maintain that no discharge of dredged or fill material will be permitted if there is a practical alternative that would have less effect on the aquatic ecosystem. If adverse impacts are unavoidable, action must be taken to restore, or create alternative wetlands.	The removal of drums and sediments will be designed to minimize placement of fill in wetland areas. If fill materials are placed in wetland areas to enable access, the affected area will be restored to the extent necessary.

continued

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Surface Waters Endangered Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.; 40 CFR Part 302]	Relevant and Appropriate	Actions which affect species/habitat require consultation with DOI, FWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources.	To the extent necessary, actions will be taken to develop measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The USFWS, acting as a review agency for USEPA, will be kept informed of proposed remedial actions.
State Regulatory Authority	Floodplains Wetlands	Massachusetts Wetland Protection Act and regulations [MGL c. 131 s. 40; 310 CMR 10.00]	Applicable	These regulations include standards on dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is also regulated under these requirements.	All work to be performed within the 100 foot buffer zone will be done in accordance with the substantive requirements of these regulations.

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority	Surface water	CWA, Ambient Water Quality Criteria [40 CFR 131; Quality Criteria for Water 1986]	Relevant and Appropriate	Federal AWQC include (1) health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds and (2) acute and chronic toxicity values for the protection of aquatic life. AWQC for the protection of human health provide protective concentrations for exposure from ingesting contaminated water and contaminated aquatic organisms, and from ingesting contaminated aquatic organisms alone. Remedial actions involving contaminated surface water or discharge of contaminants to surface water must consider the uses of the water and the circumstances of the release or threatened release.	Sediment removal will be conducted in a manner to prevent AWQC exceedances. Supernatant from dredged spoil dewatering will be monitored to prevent AWQC exceedances in Cold Spring Brook Pond. AWQC will be used to develop appropriate discharge limitations.

continued

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARs FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Groundwater	SDWA, National Primary Drinking Water Standards, MCLs [40 CFR Parts 141.11 - 141.16 and 141.50 - 141.53]	Relevant and Appropriate	The NPDWR establishes MCLs and MCLGs for several common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health goals.	The MCL for bis(2-ethylhexyl)phthalate will be met under average conditions and the MCL for arsenic will be met under average and maximum conditions. MCLs are not exceeded at Patton Well.

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
State Regulatory Authority	Surface water	Massachusetts Surface Water Quality Standards [314 CMR 4.00]	Applicable	Massachusetts Surface Water Quality Standards designate the most sensitive uses for which surface waters of the Commonwealth are to be enhanced, maintained, and protected, and designate minimum water quality criteria for sustaining the designated uses. Surface waters at Fort Devens are classified as Class B. Surface waters assigned to this class are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation.	Sediment removal will be conducted in a manner to prevent exceedances of Surface Water Quality Criteria. Supernatant from dredged spoil dewatering will be monitored to prevent exceedances of criteria in Cold Spring Brook Pond. To the extent necessary, Surface Water Quality Criteria will be used to develop discharge limitations.

continued

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority	Control of surface water runoff. Direct discharge to surface water.	CWA, NPDES Permit Program [40 CFR 122,125]	Applicable	The NPDES permit program specifies the permissible concentration or level of contaminants in the discharge from any point source to waters of the United States.	Construction activities will be controlled to meet USEPA discharge requirements. On-site surface water discharges will meet the substantive requirements of these regulations.
State Regulatory Authority	Excavation/ construction.	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 - 7.00]	Applicable	Particulate emissions from remedial activities must not exceed an annual geometric mean of 50 g/m^3 and a maximum 24-hour concentration of 150 mg/m^3 (primary standard). Carbon monoxide, nitrogen dioxide, and lead are also regulated. A permit and BACT approval are required prior to operation. Visible emissions are limited.	Particulate emissions will be managed through engineering controls.
	Solid waste landfill construction, operation, closure, and post-closure care.	Massachusetts Solid Waste Management Regulations [310 CMR 19.100]	Relevant and Appropriate	These regulations outline the requirements for construction, operation, closure, and post closure at solid waste management facilities in the Commonwealth of Massachusetts.	The proposed groundwater monitoring program meets the requirements of 310 CMR 19.118 and 19.132.

continued

TABLE 5-6
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-2

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Construction over/in a waterway.	Massachusetts Waterways Act [MGL c. 91; 310 CMR 9.00]	Relevant and Appropriate	The Massachusetts Waterways Act and regulations require that a license from MADEP be obtained for any work in or over any tidelands, river or stream (with respect to which public funds have been expended), or great pond, or outlet thereof.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations.
	Activities that potentially affect surface water quality.	Massachusetts Water Quality Certification and Certification for Dredging [314 CMR 9.00]	Applicable	For activities that require a MADEP Wetlands Order of Conditions to dredge or fill navigable waters or wetlands, a Chapter 91 Waterways License, a USACE permit or any major permit issued by USEPA (e.g., CWA NPDES permit), a Massachusetts Division of Water Pollution Control Water Quality Certification is required pursuant to 314 CMR 9.00.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations. This remedial alternative will be designed to attain and maintain Massachusetts Water Quality Standards in affected waters.

Notes:

AWQC = Ambient Water Quality Criteria
BACT = Best Available Control Technology
CWA = Clean Water Act
DOI = U.S. Department of Interior
FWS = U.S. Fish and Wildlife Service
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
NMFS = National Marine Fisheries Service
NPDES = National Pollutant Discharge Elimination System
NPDWR = National Primary Drinking Water Standards
USACE = U.S. Army Corps of Engineers

TABLE 5-7
ALTERNATIVE CSBL-2: COST SUMMARY TABLE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ITEM	COST
DIRECT COSTS	
Site preparation and mobilization	$157,000
Sediment removal and disposal	$786,000
Wetland restoration	$31,000
Monitoring wells	$11,000
Drum removal and disposal	$32,000
Landfill bank and surface improvements	$138,000
Institutional controls and educational programs	$13,000
TOTAL DIRECT COST	$1,168,000
INDIRECT COSTS	
Health and safety @ 5% of total direct cost	$58,000
Legal, Administrative, Permitting @ 5% of total direct cost	$58,000
Engineering @ 10% of total direct cost	$117,000
Services during construction @ 10% of total direct cost	$117,000
TOTAL INDIRECT COST	$350,000
TOTAL CAPITAL (DIRECT AND INDIRECT) COST	$1,518,000
OPERATION AND MAINTENANCE COSTS	
Total annual operating and maintenance costs for 5-year activities	$13,000
Total present worth of O&M costs @ 7% for 5 years	$53,000
Total annual operating and maintenance costs for 30-year activities	$33,000
Total present worth of O&M costs @ 7% for 30 years	$409,000
TOTAL PRESENT WORTH OF O&M COSTS	$462,000
TOTAL PRESENT WORTH OF ALTERNATIVE	$1,980,000

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Table 5-8
Synopsis of Federal and State ARARs for Alternative CSBL-3

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal Regulatory Authority	Floodplains	Floodplain Management Executive Order No. 11988 [40 CFR Part 6, App. A]	Applicable	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/ construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	If no practicable alternative exists, drum removal, hot-spot sediment dredging, and cover system installation will be designed to minimize alteration/destruction of floodplain area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.
	Wetlands	Protection of Wetlands Executive Order No. 11990 [40 CFR Part 6, App. A]	Applicable	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas, and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.	If no practicable alternative exists, drum removal, hot-spot sediment dredging, and cover system installation will be designed to minimize alteration/destruction of wetland area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.

continued

TABLE 5-8
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-3

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Wetlands Aquatic Ecosystem	CWA, Dredge or Fill Requirements Section 404 [33 CFR Part 230; 40 CFR Part 230]	Applicable	Section 404 of the CWA regulates the discharge of dredged or fill materials to U.S. waters, including wetlands. Filling wetlands would be considered a discharge of fill materials. Procedures for complying with regulatory conditions are contained in 33 CFR Part 323. Guidelines for Specification of Disposal Sites for Dredged or Fill material at 40 CFR Part 230, promulgated under CWA Section 404(b)(1), maintain that no discharge of dredged or fill material will be permitted if there is a practical alternative that would have less effect on the aquatic ecosystem. If adverse impacts are unavoidable, action must be taken to restore, or create alternative wetlands.	The removal of drums/sediments and installation of a cover will be designed to minimize placement of fill in wetland areas. If this alternative is chosen, the affected areas will be restored to the extent necessary.

continued

Table 5-8
Synopsis of Federal and State ARARs for Alternative CSBL-3

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
	Surface Waters Endangered Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.; 40 CFR Part 302]	Relevant and Appropriate	Actions which affect species/habitat require consultation with DOI, FWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources.	To the extent necessary, actions will be taken to develop measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The USFWS, acting as a review agency for USEPA, will be kept informed of proposed remedial actions.
State Regulatory Authority	Floodplains Wetlands	Massachusetts Wetland Protection Act and regulations [MGL c. 131 s. 40; 310 CMR 10.00]	Applicable	These regulations include standards on dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is also regulated under these requirements.	All work to be performed within the 100 foot buffer zone will be done in accordance with the substantive requirements of these regulations.

Table 5-8
Synopsis of Federal and State ARARs for Alternative CSBL-3

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Chemical Medium	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal Regulatory Authority	Surface water	CWA, Ambient Water Quality Criteria [40 CFR 131; Quality Criteria for Water 1986]	Relevant and Appropriate	Federal AWQC include (1) health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds and (2) acute and chronic toxicity values for the protection of aquatic life. AWQC for the protection of human health provide protective concentrations for exposure from ingesting contaminated water and contaminated aquatic organisms, and from ingesting contaminated aquatic organisms alone. Remedial actions involving contaminated surface water or discharge of contaminants to surface water must consider the uses of the water and the circumstances of the release or threatened release.	Sediment removal will be conducted in a manner to prevent AWQC exceedances. Supernatant from dredged spoil dewatering will be monitored to prevent AWQC exceedances in Cold Spring Brook Pond. AWQC will be used to develop appropriate discharge limitations.

TABLE 5-8
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-3

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Groundwater	SDWA, National Primary Drinking Water Standards, MCLs [40 CFR Parts 141.11 - 141.16 and 141.50 - 141.53]	Relevant and Appropriate	The NPDWR establishes MCLs and MCLGs for several common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health goals.	The MCL for bis(2-ethylhexyl)-phthalate will be met under average conditions and the MCL for arsenic will be met under average and maximum conditions. MCLs are not exceeded at Patton Well.

continued

TABLE 5-8
SYNOPSIS OF FEDERAL AND STATE ARARs FOR ALTERNATIVE CSBL-3

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
State Regulatory Authority	Surface water	Massachusetts Surface Water Quality Standards [314 CMR 4.00]	Applicable	Massachusetts Surface Water Quality Standards designate the most sensitive uses for which surface waters of the Commonwealth are to be enhanced, maintained, and protected, and designate minimum water quality criteria for sustaining the designated uses. Surface waters at Fort Devens are classified as Class B. Surface waters assigned to this class are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation.	Sediment removal will be conducted in a manner to prevent exceedances of Surface Water Quality Criteria. Supernatant from dredged spoil dewatering will be monitored to prevent exceedances of criteria in Cold Spring Brook Pond. To the extent necessary, Surface Water Quality Criteria will be used to develop discharge limitations.

Table 5-8
Synopsis of Federal and State ARARS For Alternative CSBL-3

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Action	Requirements	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal Regulatory Authority	Control of surface water runoff. Direct discharge to surface water.	CWA, NPDES Permit Program [40 CFR 122,125]	Applicable	The NPDES permit program specifies the permissible concentration or level of contaminants in the discharge from any point source to waters of the United States.	Construction activities will be controlled to meet USEPA discharge requirements. On-site surface water discharges will meet the substantive requirements of these regulations.
State Regulatory Authority	Excavation/ construction.	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 - 7.00]	Applicable	Particulate emissions from remedial activities must not exceed an annual geometric mean of 50 g/m^3 and a maximum 24-hour concentration of 150 mg/m^3 (primary standard). Carbon monoxide, nitrogen dioxide, and lead are also regulated. A permit and BACT approval are required prior to operation. Visible emissions are limited.	Particulate emissions will be managed through engineering controls.
	Solid waste landfill construction, operation, closure, and post-closure care.	Massachusetts Solid Waste Management Regulations [310 CMR 19.100]	Relevant and Appropriate	These regulations outline the requirements for construction, operation, closure, and post closure at solid waste management facilities in the Commonwealth of Massachusetts.	The proposed groundwater monitoring program meets the requirements of 310 CMR 19.118 and 19.132. Proposed cover system design conforms with the intent of 310 CMR 19.112, although it may be considered an Alternative Cover System Design by MADEP (310 CMR 19.113).

continued

TABLE 5-8
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-3

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Construction over/in a waterway.	Massachusetts Waterways Act [MGL c. 91; 310 CMR 9.00]	Relevant and Appropriate	The Massachusetts Waterways Act and regulations require that a license from MADEP be obtained for any work in or over any tidelands, river or stream (with respect to which public funds have been expended), or great pond, or outlet thereof.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations.
	Activities that potentially affect surface water quality.	Massachusetts Water Quality Certification and Certification for Dredging [314 CMR 9.00]	Applicable	For activities that require a MADEP Wetlands Order of Conditions to dredge or fill navigable waters or wetlands, a Chapter 91 Waterways License, a USACE permit or any major permit issued by USEPA (e.g., CWA NPDES permit), a Massachusetts Division of Water Pollution Control Water Quality Certification is required pursuant to 314 CMR 9.00.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations. This remedial alternative will be designed to attain and maintain Massachusetts Water Quality Standards in affected waters.

Notes:

AWQC = Ambient Water Quality Criteria
BACT = Best Available Control Technology
CWA = Clean Water Act
DOI = U.S. Department of Interior
FWS = U.S. Fish and Wildlife Service
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
NMFS = National Marine Fisheries Service
NPDES = National Pollutant Discharge Elimination System
NPDWR = National Primary Drinking Water Standards
USACE = U.S. Army Corps of Engineers

TABLE 5-9
ALTERNATIVE CSBL-3: COST SUMMARY TABLE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ITEM	COST
DIRECT COSTS	
Site preparation and mobilization	$215,000
Sediment removal and disposal	$1,131,000
Wetland restoration	$94,000
Monitoring wells	$11,000
Drum removal and disposal	$32,000
Cover placement	$778,000
Institutional controls and educational programs	$13,000
TOTAL DIRECT COST	$2,274,000
INDIRECT COSTS	
Health and safety @ 5% of total direct cost	$114,000
Legal, Administrative, Permitting @ 5% of total direct cost	$114,000
Engineering @ 10% of total direct cost	$227,000
Services during construction @ 10% of total direct cost	$227,000
TOTAL INDIRECT COST	$682,000
TOTAL CAPITAL (DIRECT AND INDIRECT) COST	$2,956,000
OPERATION AND MAINTENANCE COSTS	
Total annual operating and maintenance costs for 5-year activities	$13,000
Total present worth of O&M costs @ 7% for 5 years	$53,000
Total annual operating and maintenance costs for 30-year activities	$37,000
Total present worth of O&M costs @ 7% for 30 years	$459,000
TOTAL PRESENT WORTH OF O&M COSTS	$512,000
TOTAL PRESENT WORTH OF ALTERNATIVE	$3,468,000

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Table 5-10
Synopsis of Federal and State ARARs for Alternative CSBL-4

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Location Characteristic	Requirement	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal Regulatory Authority	Floodplains	Floodplain Management Executive Order No. 11988 [40 CFR Part 6, App. A]	Applicable	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/ construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.	If no practicable alternative exists, drum removal, hot-spot sediment dredging, and landfill excavation will be designed to minimize alteration/destruction of floodplain area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.
	Wetlands	Protection of Wetlands Executive Order No. 11990 [40 CFR Part 6, App. A]	Applicable	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas, and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.	If no practicable alternative exists, drum removal, hot-spot sediment dredging, and landfill excavation will be designed to minimize alteration/destruction of floodplain area. If this alternative is chosen, wetlands adversely affected by remedial action will be restored to the extent necessary.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Wetlands Aquatic Ecosystem	CWA, Dredge or Fill Requirements Section 404 [33 CFR Part 230; 40 CFR Part 230]	Applicable	Section 404 of the CWA regulates the discharge of dredged or fill materials to U.S. waters, including wetlands. Filling wetlands would be considered a discharge of fill materials. Procedures for complying with regulatory conditions are contained in 33 CFR Part 323. Guidelines for Specification of Disposal Sites for Dredged or Fill material at 40 CFR Part 230, promulgated under CWA Section 404(b)(1), maintain that no discharge of dredged or fill material will be permitted if there is a practical alternative that would have less effect on the aquatic ecosystem. If adverse impacts are unavoidable, action must be taken to restore, or create alternative wetlands.	The removal of drums/ sediments and installation of a cover will be designed to minimize placement of fill in wetland areas. If this alternative is chosen, the affected areas will be restored to the extent necessary.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Surface Waters Endangered Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.; 40 CFR Part 302]	Relevant and Appropriate	Actions which affect species/habitat require consultation with DOI, FWS, NMFS, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources.	To the extent necessary, actions will be taken to develop measures to prevent, mitigate, or compensate for project related impacts to habitat and wildlife. The USFWS, acting as a review agency for USEPA, will be kept informed of proposed remedial actions.
	Endangered Species	Endangered Species Act [16 USC 1531 et seq.; 50 CFR Part 402]	Applicable	This act requires action to avoid jeopardizing the continued existence of listed endangered or threatened species or modification of their habitat.	The protection of endangered species and their habitat will be considered during development of consolidation facility.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	LOCATION CHARACTERISTIC	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
State Regulatory Authority	Floodplains Wetlands	Massachusetts Wetland Protection Act and regulations [MGL c. 131 s. 40; 310 CMR 10.00]	Applicable	These regulations include standards on dredging, filling, altering, or polluting inland wetlands. Work within 100 feet of a wetland is also regulated under these requirements.	All work to be performed within the 100 foot buffer zone will be done in accordance with the substantive requirements of these regulations.
	Endangered Species	Massachusetts Endangered Species Act and implementing regulations [MGL c. 131A, s. 1 et seq.; 321 CMR 8.00]	Applicable	Actions must be conducted in a manner which minimizes the impact to Massachusetts listed endangered species and species listed by the Massachusetts Natural Heritage Program.	The protection of state listed species and their habitat will be considered during the development of the consolidation facility.

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
Federal Regulatory Authority	Surface water	CWA, Ambient Water Quality Criteria [40 CFR 131; Quality Criteria for Water 1986]	Relevant and Appropriate	Federal AWQC include (1) health-based criteria developed for 95 carcinogenic and noncarcinogenic compounds and (2) acute and chronic toxicity values for the protection of aquatic life. AWQC for the protection of human health provide protective concentrations for exposure from ingesting contaminated water and contaminated aquatic organisms, and from ingesting contaminated aquatic organisms alone. Remedial actions involving contaminated surface water or discharge of contaminants to surface water must consider the uses of the water and the circumstances of the release or threatened release.	Sediment removal will be conducted in a manner to prevent AWQC exceedances. Supernatant from dredged spoil dewatering will be monitored to prevent AWQC exceedances in Cold Spring Brook Pond. AWQC will be used to develop appropriate discharge limitations.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Groundwater	SDWA, National Primary Drinking Water Standards, MCLs [40 CFR Parts 141.11 - 141.16 and 141.50 - 141.53]	Relevant and Appropriate	The NPDWR establishes MCLs and MCLGs for several common organic and inorganic contaminants. MCLs specify the maximum permissible concentrations of contaminants in public drinking water supplies. MCLs are federally enforceable standards based in part on the availability and cost of treatment techniques. MCLGs specify the maximum concentration at which no known or anticipated adverse effect on humans will occur. MCLGs are non-enforceable health goals.	The MCL for bis(2-ethylhexyl)-phthalate will be met under average conditions and the MCL for arsenic will be met under average and maximum conditions. MCLs are not exceeded at Patton Well.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	CHEMICAL MEDIUM	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
State Regulatory Authority	Surface water	Massachusetts Surface Water Quality Standards [314 CMR 4.00]	Applicable	Massachusetts Surface Water Quality Standards designate the most sensitive uses for which surface waters of the Commonwealth are to be enhanced, maintained, and protected, and designate minimum water quality criteria for sustaining the designated uses. Surface waters at Fort Devens are classified as Class B. Surface waters assigned to this class are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation.	Sediment removal will be conducted in a manner to prevent exceedances of Surface Water Quality Criteria. Supernatant from dredged spoil dewatering will be monitored to prevent exceedances of criteria in Cold Spring Brook Pond. To the extent necessary, Surface Water Quality Criteria will be used to develop discharge limitations.

Table 5-10
Synopsis of Federal and State ARARS For Alternative CSBL-4

Cold Spring Brook Landfill Operable Unit
Feasibility Study for Group 1A Sites
Fort Devens, MA

Authority	Action	Requirements	Status	Requirement Synopsis	Action To Be Taken To Attain Requirement
Federal Regulatory Authority	Control of surface water runoff. Direct discharge to surface water.	CWA, NPDES Permit Program [40 CFR 122,125]	Applicable	The NPDES permit program specifies the permissible concentration or level of contaminants in the discharge from any point source to waters of the United States.	Construction activities will be controlled to meet USEPA discharge requirements. On-site surface water discharges will meet the substantive requirements of these regulations.
State Regulatory Authority	Excavation/ construction.	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 - 7.00]	Applicable	Particulate emissions from remedial activities must not exceed an annual geometric mean of 50 g/m^3 and a maximum 24-hour concentration of 150 mg/m^3 (primary standard). Carbon monoxide, nitrogen dioxide, and lead are also regulated. A permit and BACT approval are required prior to operation. Visible emissions are limited.	Particulate emissions will be managed through engineering controls.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Solid waste landfill construction, operation, closure, and post-closure care.	Massachusetts Solid Waste Management Regulations [310 CMR 19.100]	Applicable	These regulations outline the requirements for construction, operation, closure, and post closure at solid waste management facilities in the Commonwealth of Massachusetts.	The proposed groundwater monitoring program meets the requirements of 310 CMR 19.118 and 19.132. Proposed cover system design conforms with the intent of 310 CMR 19.112, although it may be considered an Alternative Cover System Design by MADEP (310 CMR 19.113). These regulations will be followed for construction, operation, closure, and post-closure of the solid waste consolidation facility.
	Construction over/in a waterway.	Massachusetts Waterways Act [MGL c. 91; 310 CMR 9.00]	Relevant and Appropriate	The Massachusetts Waterways Act and regulations require that a license from MADEP be obtained for any work in or over any tidelands, river or stream (with respect to which public funds have been expended), or great pond, or outlet thereof.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations.

continued

TABLE 5-10
SYNOPSIS OF FEDERAL AND STATE ARARS FOR ALTERNATIVE CSBL-4

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

AUTHORITY	ACTION	REQUIREMENTS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN REQUIREMENT
	Activities that potentially affect surface water quality.	Massachusetts Water Quality Certification and Certification for Dredging [314 CMR 9.00]	Applicable	For activities that require a MADEP Wetlands Order of Conditions to dredge or fill navigable waters or wetlands, a Chapter 91 Waterways License, a USACE permit or any major permit issued by USEPA (e.g., CWA NPDES permit), a Massachusetts Division of Water Pollution Control Water Quality Certification is required pursuant to 314 CMR 9.00.	Excavation, filling, and disposal activities will meet the substantive criteria and standards of these regulations. This alternative will be designed to attain and maintain Massachusetts Water Quality Standards in affected areas.

Notes:

AWQC = Ambient Water Quality Criteria
BACT = Best Available Control Technology
CWA = Clean Water Act
DOI = U.S. Department of Interior
FWS = U.S. Fish and Wildlife Service
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
NMFS = National Marine Fisheries Service
NPDES = National Pollutant Discharge Elimination System
NPDWR = National Primary Drinking Water Standards
USACE = U.S. Army Corps of Engineers

TABLE 5-11
ALTERNATIVE CSBL-4: COST SUMMARY TABLE

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ITEM	COST
DIRECT COSTS	
Site preparation and mobilization	$195,000
Sediment removal and disposal	$786,000
Wetland restoration	$156,000
Monitoring wells	$11,000
Drum removal and disposal	$32,000
Existing landfill excavation	$1,495,000
Institutional controls and educational programs	$13,000
TOTAL DIRECT COST	$2,688,000
INDIRECT COSTS	
Health and safety @ 5% of total direct cost	$134,000
Legal, Administrative, Permitting @ 5% of total direct cost	$134,000
Engineering @ 10% of total direct cost	$269,000
Services during construction @ 10% of total direct cost	$269,000
TOTAL INDIRECT COST	$806,000
TOTAL CAPITAL (DIRECT AND INDIRECT) COST	$3,494,000
OPERATION AND MAINTENANCE COSTS	
Total annual operating and maintenance costs for 5-year activities	$46,000
Total present worth of O&M costs @ 7% for 5 years	$189,000
TOTAL PRESENT WORTH OF O&M COSTS	$189,000
DISPOSAL OF WASTES AT CONSOLIDATION FACILITY	$3,105,000
TOTAL PRESENT WORTH OF ALTERNATIVE	$6,788,000

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TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
Overall Protection of Human Health and the Environment				
Human Health	• No action taken to reduce future exposure or potential risks at landfill. Relies on groundwater monitoring to protect human receptors at Patton Well.	• Protection of human health provided through implementation of institutional controls and groundwater monitoring program.	• Protection of human health provided through implementation of institutional controls and groundwater monitoring program. Landfill capping reduces potential for landfill to contribute to groundwater contamination.	• Protection of human health provided through implementation of groundwater monitoring program and landfill excavation. Excavation removes landfill as potential source of groundwater contamination at Cold Spring Brook location. • Potential for releases transferred to another Fort Devens location.
Environment	• No action taken to reduce ecological exposure and possible effects.	• Hot spot sediment dredging would reduce ecological exposure to COPCs. Drum disposal removes a potential contaminant source.	• Hot spot sediment dredging would reduce ecological exposure to COPCs. Drum disposal removes a potential contaminant source.	• Hot spot sediment dredging would reduce ecological exposure to COPCs. Drum disposal removes a potential contaminant source.
Compliance with ARARs				
Location-Specific	• No location-specific ARARS would be triggered.	• Disturbed wetlands and floodplains would be restored.	• Disturbed wetlands and floodplains would be restored.	• Disturbed wetlands and floodplains would be restored.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
Chemical-Specific	• The MCL for arsenic is met under current conditions. Average chemical concentrations meet MCL for bis(2-ethylhexyl)phthalate.	• The MCL for arsenic is met under current conditions. Average chemical concentrations meet MCL for bis(2-ethylhexyl)phthalate.	• The MCL for arsenic is met under current conditions. Average chemical concentrations meet MCL for bis(2-ethylhexyl)phthalate.	• The MCL for arsenic is met under current conditions. Average chemical concentrations meet MCL for bis(2-ethylhexyl)phthalate.
Action-Specific	• Long-term groundwater monitoring will satisfy requirements of 310 CMR 19.132.	• Long-term groundwater monitoring will satisfy requirements of 310 CMR 19.132.	• Long-term groundwater monitoring will satisfy requirements of 310 CMR 19.132. • Cover system design would meet technical requirements of 310 CMR 19.142.	• Long-term groundwater monitoring will satisfy requirements of 310 CMR 19.132. • Consolidation facility would be operated in accordance with technical requirements of 310 CMR 19.000.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
		• Although environmental permits are not required for on-site activities, remedial activities would be required to meet substantive requirements the equivalent of a USACE permit, MADEP waterways license, Massachusetts water quality certification, and Massachusetts certification for dredging.	• Although environmental permits are not required for on-site activities, remedial activities would be required to meet substantive requirements the equivalent of a USACE permit, MADEP waterways license, Massachusetts water quality certification, and Massachusetts certification for dredging.	• Although environmental permits are not required for on-site activities, remedial activities would be required to meet substantive requirements the equivalent of a USACE permit, MADEP waterways license, Massachusetts water quality certification, and Massachusetts certification for dredging.
Long-Term Effectiveness and Permanence				
Adequacy and Reliability of Controls	• Not applicable.	• Institutional controls require cooperation of local governments to be effective. Drum and sediment removal would be effective at reducing exposure.	• Institutional controls require cooperation of local governments to be effective. Drum and sediment removal would be effective at reducing exposure.	• Drum and sediment removal would be effective at reducing exposure.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
			• Landfill capping is proven effective at reducing infiltration. Effect on contaminant concentrations in groundwater cannot be quantified.	• Landfill excavation will remove landfill as potential source of groundwater and sediment contamination. Effect on contaminant concentrations in groundwater cannot be quantified.
Magnitude of Residual Risk	• Landfill remains a potential source of groundwater and sediment contamination.	• Landfill remains a potential source of groundwater and sediment contamination.	• Landfill cap mitigates landfill potential to be a source of groundwater and sediment contamination.	• Landfill is removed as a potential source of contamination at Cold Spring Brook location. • Potential for releases is transferred to Fort Devens Consolidation Facility.
Reduction of Toxicity, Mobility, or Volume through Treatment				
Reduction of Toxicity, Mobility, or Volume	• None	• Removal of drums and sediments reduces contaminant mobility.	• Removal of drums and sediments reduces contaminant mobility. • Landfill capping will reduce contaminant mobility in the unsaturated zone.	• Removal of drums and sediments reduces contaminant mobility. • Consolidation facility will contain contaminants through engineering controls.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
Irreversible Treatment	• Not applicable, no treatment.	• Drum and sediment removal is not reversible.	• Landfill capping is not considered reversible.	• Landfill excavation and consolidation is not considered reversible.
Type and Quantity of Residuals Remaining after Treatment	• Not applicable.	• Not applicable.	• Not applicable.	• Not applicable.
Statutory Preference for Treatment	• Not satisfied.	• Not satisfied.	• Not satisfied.	• Not satisfied.
Short-Term Effectiveness				
Community Protection	• No short-term effects.	• Risk to community minimized through traffic planning and control, and through ambient monitoring. • Dust controls utilized during intrusive activities.	• Risk to community minimized through traffic planning and control, and through ambient monitoring. • Dust controls utilized during intrusive activities.	• Risk to community minimized through traffic planning and control, and through ambient monitoring. • Dust controls utilized during intrusive activities.
Worker Protection	• All site activities would require following a HASP.	• All site activities would require following a HASP.	• All site activities would require following a HASP. • Increased physical hazards are associated with heavy construction.	• All site activities would require following a HASP. • Greatest level of physical hazards because of heavy construction and materials handling.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
Environmental Impacts	• No short-term effects or wetland disturbance.	• Drum and sediment removal would alter/disturb wetland community and habitat. • An estimated 0.5 acres of wetland will be disturbed by this alternative.	• Drum and sediment removal and cap installation would alter/disturb wetland community and habitat. • An estimated 1.5 acres of wetland will be disturbed by this alternative.	• Drum and sediment removal and cap installation would alter/disturb wetland community and habitat. • An estimated 2.5 acres of wetland will be disturbed by this alternative.
Time Until Action is Complete	• Additional monitoring wells could be installed within 3 months.	• It is anticipated that planning and obtaining regulatory concurrence for drum removal, hot spot sediment removal, and wetland restoration could be completed in 6 months. Field activities would require additional 2 months, but need to be done during warm weather months and low water conditions if possible.	• It is anticipated planning, design, and obtaining regulatory concurrence for drum removal, hot spot sediment removal, landfill capping, and wetland restoration could be completed in 1 year. Field activities would require an additional 3 months, but need to be done during warm weather months and low water conditions if possible.	• It is anticipated that planning, design, and obtaining regulatory concurrence for drum removal, hot spot sediment removal, landfill excavation and consolidation, and wetland restoration could be completed in 1 year. Field activities would require an additional 8 months, but need to be done during warm weather months and low water conditions if possible.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
Implementability				
Ability to Construct and Operate	• Long-term groundwater monitoring program easy to implement.	• Required engineering and construction services readily available.	• Required engineering and construction services readily available.	• Required engineering and construction services readily available.
Ease of Undertaking Additional Action	• Would not interfere with future actions.	• Would not interfere with future actions.	• Presence of cover system could increase scope of future remedial actions.	• Would not interfere with future actions.
Ability to Monitor Effectiveness	• Effectiveness would be evaluated by monitoring groundwater.	• Effectiveness would be evaluated by monitoring groundwater, sediments and biota.	• Effectiveness would be evaluated by monitoring groundwater, sediments, and biota.	• Effectiveness would be evaluated by monitoring groundwater, sediments and biota.
Ability to Obtain Approvals and Coordinate with Other Agencies	• No additional approvals required.	• Implementation of institutional controls would require cooperation by the Town of Harvard.	• Implementation of institutional controls would require cooperation by the Town of Harvard.	• Implementation of institutional controls would require cooperation by the Town of Harvard.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
		• Environmental permits not required for on-site actions; however, if difficulties arise obtaining regulatory concurrence for scope of wetland activities and restoration, the implementation and completion of remedial activities could be prolonged.	• Environmental permits not required for on-site actions; however, if difficulties arise obtaining regulatory concurrence for cover system design and scope of wetland activities and restoration, the implementation and completion of remedial activities could be prolonged.	• Environmental permits not required for on-site actions; however, if difficulties arise obtaining regulatory concurrence for cover system design, scope of wetland activities and restoration, and identifying a consolidation facility, the implementation and completion of remedial activities could be prolonged.
<u>Availability of Services and Capacity</u>	• Sampling and analytical services readily available.	• Sampling and analytical services readily available. • Engineering and construction services readily available.	• Sampling and analytical services readily available. • Engineering and construction services readily available.	• Sampling and analytical services readily available. • Engineering and construction services readily available.
<u>Availability of Equipment Specialists and Materials</u>	• Available locally.	• Drum removal technology available locally. Long stick excavator for sediment removal may need to come from specialty contractor.	• Drum removal and cap installation technology available locally. Long stick excavator for sediment removal may need to come from specialty contractor.	• Excavation/removal technologies available locally. Long stick excavator for sediment removal may need to come from specialty contractor.

(continued)

TABLE 6-1
COMPARATIVE ANALYSIS SUMMARY

COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

ASSESSMENT FACTORS	ALTERNATIVE CSBL-1: NO ACTION	ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-3: LANDFILL CAPPING/DRUM AND HOT SPOT SEDIMENT REMOVAL	ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/DRUM AND HOT SPOT SEDIMENT REMOVAL
			• A source of soil for the vegetative layer of the landfill cover must be identified.	• A source of soil for the vegetative layer of the consolidation facility cover must be identified.
Availability of Technologies	• Groundwater monitoring is a common technology.	• Drum and sediment removal technologies are commonly implemented and well proven. Qualified professionals are available to design and implement wetland restoration.	• Drum and sediment removal technologies are commonly implemented and well proven. Landfill capping is a proven technology. Qualified professionals are available to design and implement wetland restoration.	• Drum and sediment removal technologies are commonly implemented and well proven. Excavation technologies are well developed and proven. Qualified professionals are available to design and implement wetland restoration.
Cost				
Capital Cost	11,000	1,518,000	2,956,000	6,599,000*
Present Worth O&M Cost	372,000	462,000	512,000	189,000
Present Worth Cost	385,000	1,980,000	3,468,000	6,788,000

Notes:

*Includes solid waste disposal at consolidation facility.

COPC = Chemical of Potential Concern
HASP = Health and Safety Plan
MADEP = Massachusetts Department of Environmental Protection
MCL = Maximum Contaminant Level
USACE = U.S. Army Corps of Engineers

APPENDIX A

COST CALCULATIONS

TABLE A–1
COST SUMMARY TABLE
ALTERNATIVE CSBL–1: NO ACTION

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF NO ACTION		
Monitoring wells	$	11,000
TOTAL DIRECT COST OF NO ACTION	$	11,000
INDIRECT COST OF NO ACTION		
Health and Safety @ 5% of Total Direct Cost	$	0
Legal, Administration, Permitting @ 5% of Total Direct Cost		0
Engineering @ 10% of Total Direct Cost		1,000
Services During Construction @ 10% of Total Direct Cost		1,000
TOTAL INDIRECT COST OF NO ACTION	$	2,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	13,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating and Maintenance Costs	$	30,000
TOTAL PRESENT WORTH OF O&M COSTS (7% FOR 30 YEARS)	$	372,000
TOTAL COST FOR NO ACTION	$	385,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-1: NO ACTION	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-1: NO ACTION COST SUMMARY TABLE DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF ALTERNATIVE CSBL-1: NO ACTION				
MONITORING WELLS				$11,000
TOTAL DIRECT COST OF ALTERNATIVE CSBL-1: NO ACTION				$11,000
INDIRECT COST OF ALTERNATIVE CSBL-1: NO ACTION				
HEALTH AND SAFETY			5.00%	$0
LEGAL, ADMIN, PERMITTING			5.00%	0
ENGINEERING			10.00%	1,000
SERVICES DURING CONSTRUCTION			10.00%	1,000
TOTAL INDIRECT COST OF ALTERNATIVE CSBL-1: NO ACTION				$2,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$13,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL OPERATING AND MAINTENANCE COSTS				$30,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$372,000
TOTAL COST OF ALTERNATIVE CSBL-1: NO ACTION				$385,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-1: NO ACTION	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-1: NO ACTION

DIRECT COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
MONITORING WELLS - 4" DIA x 30' DEEP	2	EA	4500.00	$9,000
UNDEVELOPED DESIGN DETAILS ~25%				2,000
TOTAL MONITORING WELLS				$11,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-1: NO ACTION
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-1: NO ACTION ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SAMPLE COLLECTION, 7 WELLS, SEMI-ANNUALLY (INCLUDES WELL PURGE, SAMPLE COLLECTION AND SHIPPING)	2	LS	2700.00	$5,400
GROUNDWATER SAMPLE ANALYSIS 7 SAMPLES PLUS 2 SAMPLE QA/QC EQUIVALENT SEMI-ANNUALLY, SVOCs, INORGANICS, WATER QUALITY PARAMETERS	18	SMPL	900.00	16,200
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	15000.00	2,608
UNDEVELOPED DESIGN DETAILS ~25%				5,792
TOTAL ANNUAL O&M COSTS				$30,000

TABLE A–2
COST SUMMARY TABLE
ALTERNATIVE CSBL–2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL		
Site preparation and mobilization	$	157,000
Sediment removal and disposal		786,000
Wetland restoration		31,000
Monitoring wells		11,000
Drum removal and disposal		32,000
Landfill bank and surface improvements		138,000
Institutional controls		13,000
TOTAL DIRECT COST OF DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	$	1,168,000
INDIRECT COST OF DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL		
Health and Safety @ 5% of Total Direct Cost	$	58,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		58,000
Engineering @ 10% of Total Direct Cost		117,000
Services During Construction @ 10% of Total Direct Cost		117,000
TOTAL INDIRECT COST OF DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	$	350,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	1,518,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating and Maintenance Costs for Five Year Activities	$	13,000
Total Present Worth of O&M Costs @ 7% for 5 Years	$	53,000
Total Annual Operating and Maintenance Costs for Thirty Year Activities	$	33,000
Total Present Worth of O&M Costs @ 7% for 30 Years	$	409,000
TOTAL PRESENT WORTH OF O&M COSTS	$	462,000
TOTAL COST OF DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	$	1,980,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES JOB # 7005-04
ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL COST SUMMARY TABLE DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL				
SITE PREPARATION AND MOBILIZATION				$157,000
SEDIMENT REMOVAL AND DISPOSAL				786,000
WETLAND RESTORATION				31,000
MONITORING WELLS				11,000
DRUM REMOVAL AND DISPOSAL				32,000
LANDFILL BANK AND SURFACE IMPROVEMENTS				138,000
INSTITUTIONAL CONTROLS				13,000
TOTAL DIRECT COST OF ALTERNATIVE CSBL-2: DRUM REMOVAL/ HOT SPOT SEDIMENT REMOVAL				$1,168,000
INDIRECT COST OF ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL				
HEALTH AND SAFETY			5.00%	$58,000
LEGAL, ADMIN, PERMITTING			5.00%	58,000
ENGINEERING			10.00%	117,000
SERVICES DURING CONSTRUCTION			10.00%	117,000
TOTAL INDIRECT COST OF ALTERNATIVE CSBL-2: DRUM REMOVAL/ HOT SPOT SEDIMENT REMOVAL				$350,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$1,518,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS FOR FIVE YEAR ACTIVITIES				$13,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR FIVE YEARS)				$53,000
TOTAL ANNUAL O&M COSTS FOR THIRTY YEAR ACTIVITIES				$33,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$409,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$462,000
TOTAL COST OF ALTERNATIVE CSBL-2: DRUM REMOVAL/ HOT SPOT SEDIMENT REMOVAL				$1,980,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
ACCESS ROAD SEDIMENT AREA 1				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	$383
GRADE	200	CY	2.00	400
GRAVEL - 12" THICK	360	CY	15.00	5,400
FILTER FABRIC	4800	SF	0.10	480
ACCESS ROAD SEDIMENT AREA 2				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	383
GRADE	150	CY	2.00	300
GRAVEL - 12" THICK	340	CY	15.00	5,100
FILTER FABRIC	4800	SF	0.10	480
PARKING AREA				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
SEDIMENT DEWATERING PAD				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
GRAVEL - 12" THICK	1210	SY	3.50	4,235
LINER	10000	SF	0.60	6,000
SUMP & SUMP PUMP	1	LS	2500.00	2,500
DECON AREA - 10'x20'	3	EA	1000.00	3,000
LINED/BERMED DRUM STORAGE AREA				
CLEAR & GRUB LIGHT VEGETATION	0.01	AC	3825.00	38
GRADE	20	CY	2.00	40
LINER	400	SF	0.60	240
SUBTOTAL SITE PREPARATION				$32,531

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				$32,531
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	2	EA	1000.00	2,000
LONG STICK EXCAVATOR	2	EA	1000.00	2,000
FRAC TANK	4	EA	250.00	1,000
DEWATERING PUMP & HOSE	2	EA	100.00	200
OFFICE TRAILER	2	MON	150.00	300
STORAGE TRAILER	2	MON	150.00	300
TRAILER DELIVERY, SET-UP, REMOVAL	2	EA	300.00	600
TOILET	8	WK	25.00	200
WATER COOLER	8	WK	25.00	200
WATER	40	DAY	15.00	600
TELEPHONE SERVICE	2	MON	500.00	1,000
ELECTRICITY	1	LS	1000.00	1,000
PICK-UP (2 EA)	4	MON	1000.00	4,000
OFFICE EQUIPMENT	2	MON	1000.00	2,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (2 MON*210HR/MON)	420	MNHR	60.00	25,200
FOREMAN (2 MON*210HR/MON)	420	MNHR	50.00	21,000
CLERK/TYPIST (2 MON*168HR/MON)	336	MNHR	25.00	8,400
UNDEVELOPED DESIGN DETAILS ~25%				31,449
TOTAL SITE PREPARATION AND MOBILIZATION				$157,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES
ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
JOB # 7005-04

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT
FT. DEVENS, MASSACHUSETTS
DATE 14-Dec-94

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

SEDIMENT REMOVAL AND DISPOSAL

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
CONSTRUCT SILT BARRIER AROUND CONTAMINATED AREAS	400	LF	25.00	$10,000
EXCAVATE WITH CLAMSHELL 1200 CY SEDIMENTS + 700 CY ACCESS ROADS/WORK PLATFORMS	19	DAY	1125.00	21,375
HAUL SEDIMENTS TO DEWATERING PAD (2 EA DUMP TRUCK & DRIVER)	38	DAY	750.00	28,500
LOAD DEWATERED SEDIMENTS FOR TRANSPORTATION TO DISPOSAL AREA (FRONT END LOADER & OPERATOR)	10	DAY	950.00	9,500
LABORERS - 2 EA FOR 25 DAYS	400	MNHR	30.00	12,000
TCLP TESTING	2	SMPL	1400.00	2,800
ON-SITE STABILIZATION OF SEDIMENTS WITH SAND	600	CY	15.00	9,000
TRANSPORTATION AND DISPOSAL				
DEWATERED & STABILIZED SEDIMENT	1800	TON	180.00	324,000
ACCESS ROADS/WORK PLATFORMS	1050	TON	180.00	189,000
TREATMENT OF DEWATERING WATER	1	LS	21800.00	21,800
PUMP WATER FROM DEWATERING PAD TO PONDS	12	DAY	50.00	600
UNDEVELOPED DESIGN DETAILS ~25%				157,425
TOTAL SEDIMENT REMOVAL AND DISPOSAL				$786,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
WETLAND RESTORATION AND MONITORING WELLS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
WETLAND RESTORATION	0.5	AC	50000.00	$25,000
UNDEVELOPED DESIGN DETAILS ~25%				6,000
TOTAL WETLAND RESTORATION				$31,000
MONITORING WELLS				
4" DIA x 30' DEEP	2	EA	4500.00	$9,000
UNDEVELOPED DESIGN DETAILS ~25%				2,000
TOTAL MONITORING WELLS				$11,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

DRUM REMOVAL AND DISPOSAL DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
EXCAVATE & REMOVE DRUMS				
BACKHOE & OPERATOR	3	DAY	1350.00	$4,050
LABORER - 2 EA, 5 DAYS	80	MNHR	30.00	2,400
OVERPACK DRUMS	4	EA	150.00	600
TRANSPORT DRUMS TO STAGING AREA DUMP TRUCK & DRIVER	3	DAY	750.00	2,250
TCLP TESTING OF DRUM CONTENTS	7	EA	1400.00	9,800
TRANSPORT DRUMS TO DISPOSAL SITE	14	EA	125.00	1,750
DRUM DISPOSAL - EMPTY	3	EA	40.00	120
LANDFILL	9	EA	350.00	3,150
INCINERATOR	2	EA	750.00	1,500
UNDEVELOPED DESIGN DETAILS ~25%				6,380
TOTAL DRUM REMOVAL AND DISPOSAL				$32,000
LANDFILL BANK AND SURFACE IMPROVEMENTS				
BACKHOE & OPERATOR	15	DAY	1350.00	$20,250
LABORER - 2 EA, 15 DAYS	240	MNHR	30.00	7,200
DOZER & OPERATOR	15	DAY	1500.00	22,500
DUMP TRUCK & DRIVER	15	DAY	750.00	11,250
FILL/COMMON BORROW	650	CY	7.50	4,875
TOPSOIL/VEGETATIVE SOIL	110	CY	9.50	1,045
SEED, FERTILIZE, MULCH	17600	SY	0.40	7,040
TRANSPORT/DISPOSE OF DEBRIS	50	CY	180.00	9,000
RIPRAP	500	CY	30.00	15,000
GUARD RAIL ALONG ROAD	1000	LF	12.50	12,500
UNDEVELOPED DESIGN DETAILS ~25%				27,340
TOTAL LANDFILL BANK AND SURFACE IMPROVEMENTS				$138,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

INSTITUTIONAL CONTROLS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
INSTITUTIONAL CONTROLS	1	LS	10000.00	$10,000
UNDEVELOPED DESIGN DETAILS ~25%				3,000
TOTAL INSTITUTIONAL CONTROLS				$13,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES
ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL
JOB # 7005-04

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT
FT. DEVENS, MASSACHUSETTS
DATE 14-Dec-94

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-2: DRUM REMOVAL/HOT SPOT SEDIMENT REMOVAL

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
O&M COSTS OCCURING OVER FIVE YEARS				
WETLANDS RESTORATION MONITORING (5 YEARS)				
1 DAY @ 2 MEN/DAY, SEMI-ANNUAL	32	MNHR	75.00	$2,400
BIOMONITORING, BIENNIALLY (5 YEARS	0.4831	LS	15000.00	7,246
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	2500.00	435
UNDEVELOPED DESIGN DETAILS ~25%				2,919
TOTAL ANNUAL O&M COSTS FOR 5 YEAR ACTIVITIES				$13,000
O&M COSTS OCCURING OVER THIRTY YEARS				
ENVIRONMENTAL MONITORING				
SEDIMENT SAMPLE COLLECTION 4 LOCATIONS, ONCE EVERY 5 YEARS	0.1739	LS	1200.00	$209
SEDIMENT SAMPLE ANALYSIS, ONCE EVERY 5 YEARS, 4 SAMPLES PLUS 1 QA/QC, SVOCs AND INORGANICS ANNUALIZED	0.8695	SMPL	715.00	622
GROUNDWATER SAMPLE COLLECTION 7 WELLS, SEMI-ANNUALLY (INCLUDES WELL PURGE, SAMPLE COLLECTION, AND SHIPPING)	2	LS	2700.00	5,400
GROUNDWATER SAMPLE ANALYSIS 7 SAMPLES PLUS 2 SAMPLE QA/QC EQUIVALENT SEMI-ANNUALLY, SVOCs, INORGANICS, WATER QUALITY PARAMETERS	18	SMPL	900.00	16,200
FIVE YEAR EDUCATIONAL PROGRAM PUBLIC MEETING ANNUALIZED	0.1739	LS	5000.00	869
TWO YEAR DATA REPORT TO MADEP ANNUALIZED	0.4831	LS	1000.00	483
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	15000.00	2,608
UNDEVELOPED DESIGN DETAILS ~25%				6,609
TOTAL ANNUAL O&M COSTS FOR 30 YEAR ACTIVITIES				$33,000

TABLE A-3
COST SUMMARY TABLE
ALTERNATIVE CSBL-3: LAND CAPPING/HOT SPOT SEDIMENT REMOVAL

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF LAND CAPPING/HOT SPOT SEDIMENT REMOVAL		
Site preparation and mobilization	$	215,000
Sediment removal and disposal		1,131,000
Wetland restoration		94,000
Monitoring wells		11,000
Drum removal and disposal		32,000
Cover placement		778,000
Institutional controls		13,000
TOTAL DIRECT COST OF LAND CAPPING/HOT SPOT SEDIMENT REMOVAL	$	2,274,000
INDIRECT COST OF LAND CAPPING/HOT SPOT SEDIMENT REMOVAL		
Health and Safety @ 5% of Total Direct Cost	$	114,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		114,000
Engineering @ 10% of Total Direct Cost		227,000
Services During Construction @ 10% of Total Direct Cost		227,000
TOTAL INDIRECT COST OF LAND CAPPING/HOT SPOT SEDIMENT REMOVAL	$	682,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	2,956,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating and Maintenance Costs for Five Year Activities	$	13,000
Total Present Worth of O&M Costs @ 7% for 5 Years	$	53,000
Total Annual Operating and Maintenance Costs for Thirty Year Activities	$	37,000
Total Present Worth of O&M Costs @ 7% for 30 Years	$	459,000
TOTAL PRESENT WORTH OF O&M COSTS	$	512,000
TOTAL COST OF LAND CAPPING/HOT SPOT SEDIMENT REMOVAL	$	3,468,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/
HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL
COST SUMMARY TABLE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL				
SITE PREPARATION AND MOBILIZATION				$215,000
SEDIMENT REMOVAL AND DISPOSAL				1,131,000
WETLAND RESTORATION				94,000
MONITORING WELLS				11,000
DRUM REMOVAL AND DISPOSAL				32,000
COVER PLACEMENT				778,000
INSTITUTIONAL CONTROLS				13,000
TOTAL DIRECT COST OF ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL				$2,274,000
INDIRECT COST OF ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL				
HEALTH AND SAFETY			5.00%	$114,000
LEGAL, ADMIN, PERMITTING			5.00%	114,000
ENGINEERING			10.00%	227,000
SERVICES DURING CONSTRUCTION			10.00%	227,000
TOTAL INDIRECT COST OF ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL				$682,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$2,956,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS FOR FIVE YEAR ACTIVITIES				$13,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR FIVE YEARS)				$53,000
TOTAL ANNUAL O&M COSTS FOR THIRTY YEAR ACTIVITIES				$37,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$459,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$512,000
TOTAL COST OF ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL				$3,468,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
ACCESS ROAD SEDIMENT AREA 1				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	$383
GRADE	200	CY	2.00	400
GRAVEL - 12" THICK	360	CY	15.00	5,400
FILTER FABRIC	4800	SF	0.10	480
ACCESS ROAD SEDIMENT AREA 2				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	383
GRADE	150	CY	2.00	300
GRAVEL - 12" THICK	340	CY	15.00	5,100
FILTER FABRIC	4800	SF	0.10	480
ACCESS ROAD FOR CAPPING - 500 LF				
CLEAR & GRUB LIGHT VEGETATION	0.35	AC	3825.00	1,339
GRADE	375	CY	2.00	750
GRAVEL - 24" THICK	1450	CY	3.50	5,075
FILTER FABRIC	17850	SF	0.10	1,785
PARKING AREA				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
SEDIMENT DEWATERING PAD				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
GRAVEL - 12" THICK	1210	SY	3.50	4,235
LINER	10000	SF	0.60	6,000
SUMP & SUMP PUMP	1	LS	2500.00	2,500
DECON AREA - 10'x20'	3	EA	1000.00	3,000
LINED/BERMED DRUM STORAGE AREA				
CLEAR & GRUB LIGHT VEGETATION	0.01	AC	3825.00	38
GRADE	20	CY	2.00	40
LINER	400	SF	0.60	240
CAP MATERIALS STOCKPILE AREA				
CLEAR & GRUB LIGHT VEGETATION	1	AC	3825.00	3,825
GRADE	1600	CY	2.00	3,200
TOTAL THIS PAGE				$48,505

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				$48,505
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	2	EA	1000.00	2,000
CRANE & CLAMSHELL BUCKET	2	EA	600.00	1,200
FRAC TANK	4	EA	250.00	1,000
DEWATERING PUMP & HOSE	2	EA	100.00	200
OFFICE TRAILER	3	MON	150.00	450
STORAGE TRAILER	3	MON	150.00	450
TRAILER DELIVERY, SET-UP, REMOVAL	2	EA	300.00	600
TOILET	12	WK	25.00	300
WATER COOLER	12	WK	25.00	300
WATER	60	DAY	15.00	900
TELEPHONE SERVICE	3	MON	500.00	1,500
ELECTRICITY	3	MON	250.00	750
PICK-UP (2 EA)	6	MON	1000.00	6,000
OFFICE EQUIPMENT	3	MON	1000.00	3,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (3 MON*210HR/MON)	630	MNHR	60.00	37,800
FOREMAN (3 MON*210HR/MON)	630	MNHR	50.00	31,500
CLERK/TYPIST (3 MON*168HR/MON)	504	MNHR	25.00	12,600
UNDEVELOPED DESIGN DETAILS ~25%				42,926
TOTAL SITE PREPARATION AND MOBILIZATION				$215,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/
HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL
SEDIMENT REMOVAL AND DISPOSAL

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
CONSTRUCT SILT BARRIER AROUND CONTAMINATED AREAS	400	LF	25.00	$10,000
EXCAVATE WITH CLAMSHELL 1200 CY SEDIMENTS + 1600 CY ACCESS ROADS/WORK PLATFORMS	28	DAY	1125.00	31,500
HAUL SEDIMENTS TO DEWATERING PAD (2 EA DUMP TRUCK & DRIVER)	56	DAY	750.00	42,000
LOAD DRY SEDIMENTS FOR TRANSPORTATION TO DISPOSAL AREA (FRONT END LOADER & OPERATOR)	14	DAY	950.00	13,300
LABORERS - 2 EA FOR 35 DAYS	560	MNHR	30.00	16,800
TCLP TESTING	2	SMPL	1400.00	2,800
ON-SITE STABILIZATION OF SEDIMENTS WITH SAND	600	CY	15.00	9,000
TRANSPORTATION & DISPOSAL				
DEWATERED AND STABILIZED SEDIMENTS	1800	TON	180.00	324,000
ACCESS ROADS/WORK PLATFORMS	2400	TON	180.00	432,000
TREATMENT OF WATER	1	LS	21800.00	21,800
PUMP WATER FROM DEWATERING PAD TO POND	28	DAY	50.00	1,400
UNDEVELOPED DESIGN DETAILS ~25%				226,400
TOTAL SEDIMENT REMOVAL AND DISPOSAL				$1,131,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/
HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL
WETLAND RESTORATION AND MONITORING WELLS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
WETLAND RESTORATION	1.5	AC	50000.00	$75,000
UNDEVELOPED DESIGN DETAILS ~25%				19,000
TOTAL WETLAND RESTORATION				$94,000
MONITORING WELLS				
4" DIA x 30' DEEP	2	EA	4500.00	$9,000
UNDEVELOPED DESIGN DETAILS ~25%				2,000
TOTAL MONITORING WELLS				$11,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL

DRUM REMOVAL AND DISPOSAL

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
EXCAVATE & REMOVE DRUMS				
BACKHOE & OPERATOR	3	DAY	1350.00	$4,050
LABORER - 2 EA, 5 DAYS	80	MNHR	30.00	2,400
OVERPACK DRUMS	4	EA	150.00	600
TRANSPORT DRUMS TO STAGING AREA DUMP TRUCK & DRIVER	3	DAY	750.00	2,250
TCLP TESTING OF DRUM CONTENTS	7	EA	1400.00	9,800
TRANSPORT DRUMS TO DISPOSAL SITE	14	EA	125.00	1,750
DRUM DISPOSAL - EMPTY	3	EA	40.00	120
LANDFILL	9	EA	350.00	3,150
INCINERATOR	2	EA	750.00	1,500

UNDEVELOPED DESIGN DETAILS ~25%	6,380
TOTAL DRUM REMOVAL AND DISPOSAL	$32,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL

COVER PLACEMENT DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SILT FENCE ALONG TOE OF LANDFILL	1500	LF	5.00	$7,500
CLEAR & GRUB SITE	4.4	AC	6000.00	26,400
LONG STICK EXCAVATOR	5	DAY	1000.00	5,000
GRADE SITE - DOZER & OPERATOR	5	DAY	1450.00	7,250
CUT LANDFILL WASTE	8100	CY	3.00	24,300
IMPORTED FILL	2500	CY	7.50	18,750
SPREAD & COMPACT WASTE & FILL	10600	CY	2.00	21,200
SPREAD & COMPACT SUBGRADE FILL	7100	CY	9.50	67,450
60 MIL VLDPE TEXTURED GEOMEMBRANE	192000	SF	0.60	115,200
10-3 SAND DRAINAGE LAYER	3550	CY	10.00	35,500
GEOTEXTILE FILTER FABRIC	21350	SY	1.44	30,744
10-3 SAND FILTER LAYER	10650	CY	10.00	106,500
VEGETATIVE MATERIAL	7100	CY	9.50	67,450
SEED, FERTILIZE, MULCH	4.4	AC	2000.00	8,800
RIPRAP	2250	CY	30.00	67,500
GUARD RAIL ALONG ROAD	1000	LF	12.50	12,500
UNDEVELOPED DESIGN DETAILS ~25%				155,956
TOTAL COVER PLACEMENT				$778,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL

INSTITUTIONAL CONTROLS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
INSTITUTIONAL CONTROLS	1	LS	10000.00	$10,000

UNDEVELOPED DESIGN DETAILS ~25%	3,000
TOTAL INSTITUTIONAL CONTROLS	$13,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL — JOB # 7005-04
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT, FT. DEVENS, MASSACHUSETTS — DATE 14-Dec-94
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
O&M COSTS OCCURING OVER FIVE YEARS				
WETLANDS RESTORATION MONITORING (5 YEARS)				
1 DAY @ 2 MEN/DAY, SEMI-ANNUAL	32	MNHR	75.00	$2,400
BIOMONITORING, BIENNIALLY FOR 5 YEARS	0.4831	LS	15000.00	7,246
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	2500.00	435
UNDEVELOPED DESIGN DETAILS ~25%				2,919
TOTAL ANNUAL O&M COSTS FOR 5 YEAR ACTIVITIES				$13,000

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
O&M COSTS OCCURING OVER THIRTY YEARS				
LANDFILL COVER MAINTENANCE				
GENERAL REPAIR				
DUMP TRUCK & DRIVER	1	DAY	665.00	$665
FRONT END LOADER & OPER	1	DAY	800.00	800
LABORER - 2 EA	16	MNHR	30.00	480
MATERIALS	1	LS	500.00	500
INSPECTION - 0.5 DAY @ 2 MEN/D	8	MNHR	75.00	600
MOWING - TRACTOR & OPERATOR	1	DAY	500.00	500
SUBTOTAL THIS PAGE				$3,545

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-3: LANDFILL CAPPING/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-3: LANDFILL CAPPING/HOT SPOT SEDIMENT REMOVAL

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
O&M COSTS OCCURING OVER THIRTY YEARS - TOTAL FROM PREVIOUS PAGE				$3,545
ENVIRONMENTAL MONITORING				
SEDIMENT SAMPLE COLLECTION 4 LOCATIONS, ONCE EVERY 5 YEARS	0.1739	LS	1200.00	209
SEDIMENT SAMPLE ANALYSIS, ONCE EVERY 5 YEARS, 4 SAMPLES PLUS 1 QA/QC, SVOCs AND INORGANICS ANNUALIZED	0.8695	SMPL	715.00	622
GROUNDWATER SAMPLE COLLECTION 7 WELLS, SEMI-ANNUALLY (INCLUDES WELL PURGE, SAMPLE COLLECTION, AND SHIPPING)	2	LS	2700.00	5,400
GROUNDWATER SAMPLE ANALYSIS 7 SAMPLES PLUS 2 SAMPLE QA/QC EQUIVALENT SEMI-ANNUALLY, SVOCs, INORGANICS, WATER QUALITY PARAMETERS	18	SMPL	900.00	16,200
FIVE YEAR EDUCATIONAL PROGRAM PUBLIC MEETING - ANNUALIZED	0.1739	LS	5000.00	869
TWO YEAR DATA REPORT TO MADEP - ANNUALIZED	0.4831	LS	1000.00	483
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	15000.00	2,608
UNDEVELOPED DESIGN DETAILS ~25%				7,064
TOTAL ANNUAL O&M COSTS FOR 30 YEAR ACTIVITIES				$37,000

TABLE A-4
COST SUMMARY TABLE
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL		
Site preparation and mobilization	$	195,000
Sediment removal and disposal		786,000
Wetland restoration		156,000
Monitoring wells		11,000
Drum removal and disposal		32,000
Existing landfill excavation		1,495,000
Institutional controls		13,000
TOTAL DIRECT COST OF LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL	$	2,688,000
INDIRECT COST OF LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL		
Health and Safety @ 5% of Total Direct Cost	$	134,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		134,000
Engineering @ 10% of Total Direct Cost		269,000
Services During Construction @ 10% of Total Direct Cost		269,000
TOTAL INDIRECT COST OF LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL	$	806,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	3,494,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating & Maintenance Costs	$	46,000
Total Present Worth of O&M Costs @ 7% for 5 Years	$	189,000
TOTAL PRESENT WORTH OF O&M COSTS	$	189,000
Total Disposal at Consolidation Facility	$	3,105,000
TOTAL COST OF LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL	$	6,788,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/ HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

COST SUMMARY TABLE DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF ALT CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL				
SITE PREPARATION AND MOBILIZATION				$195,000
SEDIMENT REMOVAL AND DISPOSAL				786,000
WETLAND RESTORATION				156,000
MONITORING WELLS				11,000
DRUM REMOVAL AND DISPOSAL				32,000
EXCAVATE EXISTING LANDFILL				1,495,000
INSTITUTIONAL CONTROLS				13,000
TOTAL DIRECT COST OF ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL				$2,688,000
INDIRECT COST OF ALT CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL				
HEALTH AND SAFETY			5.00%	$134,000
LEGAL, ADMIN, PERMITTING			5.00%	134,000
ENGINEERING			10.00%	269,000
SERVICES DURING CONSTRUCTION			10.00%	269,000
TOTAL INDIRECT COST OF ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL				$806,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$3,494,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS				$46,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR FIVE YEARS)				$189,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$189,000
TOTAL DISPOSAL AT CONSOLIDATION FACILITY				$3,105,000
TOTAL COST OF ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL				$6,788,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/
HOT SPOT SEDIMENT REMOVAL
JOB # 7005-04
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT
FT. DEVENS, MASSACHUSETTS
DATE 14-Dec-94
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
ACCESS ROAD SEDIMENT AREA 1				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	$383
GRADE	200	CY	2.00	400
GRAVEL - 12" THICK	360	CY	15.00	5,400
FILTER FABRIC	4800	SF	0.10	480
ACCESS ROAD SEDIMENT AREA 2				
CLEAR & GRUB LIGHT VEGETATION	0.1	AC	3825.00	$383
GRADE	150	CY	2.00	300
GRAVEL - 12" THICK	340	CY	15.00	5,100
FILTER FABRIC	4800	SF	0.10	480
PARKING AREA				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
SEDIMENT DEWATERING PAD				
CLEAR & GRUB LIGHT VEGETATION	0.25	AC	3825.00	956
GRADE	410	CY	2.00	820
GRAVEL - 12" THICK	1210	SY	3.50	4,235
LINER	10000	SF	0.60	6,000
SUMP & SUMP PUMP	1	LS	2500.00	2,500
DECON AREA - 10'x20'	3	EA	1000.00	3,000
LINED/BERMED DRUM STORAGE AREA				
CLEAR & GRUB LIGHT VEGETATION	0.01	AC	3825.00	38
GRADE	20	CY	2.00	40
LINER	400	SF	0.60	240
SUBTOTAL SITE PREPARATION				$32,531

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/
HOT SPOT SEDIMENT REMOVAL
JOB # 7005-04

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT
FT. DEVENS, MASSACHUSETTS
DATE 14-Dec-94

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				$32,531
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	2	EA	1000.00	2,000
CRANE & CLAMSHELL BUCKET	2	EA	600.00	1,200
FRAC TANK	4	EA	250.00	1,000
DEWATERING PUMP & HOSE	2	EA	100.00	200
OFFICE TRAILER	3	MON	150.00	450
STORAGE TRAILER	3	MON	150.00	450
TRAILER DELIVERY, SET-UP, REMOVAL	2	EA	300.00	600
TOILET - 2 EA	12	WK	25.00	300
WATER COOLER - 2 EA	12	WK	25.00	300
WATER	60	DAY	15.00	900
TELEPHONE SERVICE	3	MON	500.00	1,500
ELECTRICITY	3	MON	250.00	750
PICK-UP (2 EA)	6	MON	1000.00	6,000
OFFICE EQUIPMENT	3	MON	1000.00	3,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (3 MON*210HR/MON)	630	MNHR	60.00	37,800
FOREMAN (3 MON*210HR/MON)	630	MNHR	50.00	31,500
CLERK/TYPIST (3 MON*168HR/MON)	504	MNHR	25.00	12,600
UNDEVELOPED DESIGN DETAILS ~25%				38,899
TOTAL SITE PREPARATION AND MOBILIZATION				$195,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/
HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL
SEDIMENT REMOVAL AND DISPOSAL

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
CONSTRUCT SILT BARRIER AROUND CONTAMINATED AREAS	400	LF	25.00	$10,000
EXCAVATE WITH CLAMSHELL 1200 CY SEDIMENTS + 700 CY ACCESS ROADS/WORK PLATFORMS	19	DAY	1125.00	21,375
HAUL SEDIMENTS TO DEWATERING PAD (2 EA DUMP TRUCK & DRIVER)	38	DAY	750.00	28,500
LOAD DEWATERED SEDIMENTS FOR TRANSPORTATION TO DISPOSAL AREA (FRONT END LOADER & OPERATOR)	10	DAY	950.00	9,500
LABORERS - 2 EA FOR 25 DAYS	400	MNHR	30.00	12,000
TCLP TESTING	2	SMPL	1400.00	2,800
ON-SITE STABILIZATION OF SEDIMENTS WITH SAND	600	CY	15.00	9,000
TRANSPORTATION AND DISPOSAL				
DEWATERED & STABILIZED SEDIMENT	1800	TON	180.00	324,000
ACCESS ROADS/WORK PLATFORMS	1050	TON	180.00	189,000
TREATMENT OF DEWATERING WATER	1	LS	21800.00	21,800
PUMP WATER FROM DEWATERING PAD TO PONDS	12	DAY	50.00	600

UNDEVELOPED DESIGN DETAILS ~25%	157,425
TOTAL SEDIMENT REMOVAL AND DISPOSAL	$786,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL
WETLAND RESTORATION AND MONITORING WELLS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
WETLAND RESTORATION	2.5	AC	50000.00	$125,000
UNDEVELOPED DESIGN DETAILS ~25%				31,000
TOTAL WETLAND RESTORATION				$156,000
MONITORING WELLS				
4" DIA x 30' DEEP	2	EA	4500.00	$9,000
UNDEVELOPED DESIGN DETAILS ~25%				2,000
TOTAL MONITORING WELLS				$11,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/
HOT SPOT SEDIMENT REMOVAL
JOB # 7005-04

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT
FT. DEVENS, MASSACHUSETTS
DATE 14-Dec-94

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL
DRUM REMOVAL AND DISPOSAL

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
EXCAVATE & REMOVE DRUMS				
BACKHOE & OPERATOR	3	DAY	1350.00	$4,050
LABORER - 2 EA, 5 DAYS	80	MNHR	30.00	2,400
OVERPACK DRUMS	4	EA	150.00	600
TRANSPORT DRUMS TO STAGING AREA DUMP TRUCK & DRIVER	3	DAY	750.00	2,250
TCLP TESTING OF DRUM CONTENTS	7	EA	1400.00	9,800
TRANSPORT DRUMS TO DISPOSAL SITE	14	EA	125.00	1,750
DRUM DISPOSAL - EMPTY	3	EA	40.00	120
LANDFILL	9	EA	350.00	3,150
INCINERATOR	2	EA	750.00	1,500
UNDEVELOPED DESIGN DETAILS ~25%				6,380
TOTAL DRUM REMOVAL AND DISPOSAL				$32,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

EXCAVATE EXISTING LANDFILL DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
CLEAR & GRUB SITE	4	AC	6000.00	$24,000
SILT FENCE AT BASE OF LANDFILL	1500	LF	5.00	7,500
SUMP PUMP (2 EA) & HOSES	4	MON	2500.00	10,000
EXCAVATE & LOAD EXISTING LANDFILL MATERIAL	100000	CY	2.75	275,000
HAUL TO CONSOLIDATION LANDFILL	100000	CY	5.40	540,000
BACKFILL	25000	CY	10.00	250,000
RIPRAP	2300	CY	30.00	69,000
GUARD RAIL ALONG ROAD	1000	LF	12.50	12,500
FERTILIZE, SEED, MULCH	4	AC	2000.00	8,000
UNDEVELOPED DESIGN DETAILS ~25%				299,000
TOTAL EXCAVATE EXISTING LANDFILL				$1,495,000

APPENDIX A

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/ HOT SPOT SEDIMENT REMOVAL	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	14-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

INSTITUTIONAL CONTROLS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
INSTITUTIONAL CONTROLS	1	LS	10000.00	$10,000
UNDEVELOPED DESIGN DETAILS ~25%				3,000
TOTAL INSTITUTIONAL CONTROLS				$13,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/ HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
O&M COSTS OCCURING OVER FIVE YEARS				
ENVIRONMENTAL MONITORING				
SEDIMENT SAMPLE COLLECTION 4 LOCATIONS, ONCE EVERY 5 YEARS, ANNUALIZED	0.1739	LS	1200.00	$209
SEDIMENT SAMPLE ANALYSIS ONCE EVERY 5 YEARS, 4 SAMPLES PLUS 1 QA/QC, SVOCs AND INORGANICS ANNUALIZED	0.8695	LS	715.00	622
SAMPLE COLLECTION, 7 WELLS SEMI-ANNUALLY (INCLUDES WELL PURGE, SAMPLE COLLECTION AND SHIPPING)	2	LS	2700.00	5,400
GROUNDWATER SAMPLE ANALYSIS, 7 SAMPLES PLUS 2 QA/QC EQUIVALENT SEMI-ANNUALLY, SVOCs, INORGANICS, WATER QUALITY PARAMETERS	18	SMPL	900.00	16,200
WETLANDS RESTORATION MONITORING 1 DAY @ 2 MEN/DAY, SEMI-ANNUAL	32	MNHR	75.00	2,400
BIOMONITORING, BIENNIALLY	0.4831	LS	15000.00	7,246
FIVE YEAR EDUCATION PROGRAM PUBLIC MEETING - ANNUALIZED	0.1739	LS	5000.00	869
TWO YEAR DATA REPORT TO MADEP - ANNUALIZED	0.4831	LS	1000.00	483
FIVE YEAR SITE REVIEW - ANNUALIZED	0.1739	LS	17500.00	3,043
UNDEVELOPED DESIGN DETAILS ~25%				9,528
TOTAL ANNUAL O&M COSTS FOR 5 YEAR ACTIVITIES				$46,000

APPENDIX A

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/
HOT SPOT SEDIMENT REMOVAL
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 14-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

ALTERNATIVE CSBL-4: LANDFILL EXCAVATION/HOT SPOT SEDIMENT REMOVAL

LANDFILL COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
TOTAL DISPOSAL COSTS AT CONSOLIDATION LANDFILL (FROM APPENDIX E)				$6,552,000
TOTAL CAPACITY (IN CY) OF CONSOLIDATION LANDFILL				211,000
UNIT COST OF CONSOLIDATION LANDFILL ($/CY)				$31.05
COST FOR MATERIAL PLACED IN CONSOLIDATION LANDFILL	100000	CY	31.05	$3,105,000

APPENDIX B

SEDIMENT QUANTITY CALCULATIONS

PROJECT	COMP. BY	JOB NO.
FORT DEVENS GROUP 1A FS SEDIMENT REMOVAL @ CSBP	SWR	700504
	CHK. BY SNP	DATE 3-14-94

Approximate quantity of sediment to be removed

AREA I

Outlined area on Figure B-1 is 7090 ft^2

Remove 1 ft from 7090 ft^2 = 7090

Remove add 1 ft from 3550 ft^2 = 3550

Remove add 1 ft from 1800 ft^2 = 1800

12,440 ft^3 ≈ 460 c.y.

AREA II

OUTLINED AREA ON FIGURE B-2 IS 10,900 ft^2

Remove 1 ft from 10,900 = 10900

Remove add. 1 ft from $\frac{1}{2}\frac{\pi(40)^2}{4}$ = 628

11,528 ft^3 ≈ 427 c.y.

TOTAL = 887 c.y.

Conservative assumption: 1,200 c.y. will be removed including overage, edge of bank, etc.

A lined dewatering basin of 10,000 s.f. × 4 ft deep would provide approx. 1,500 c.y. of storage vol.

FORM 00.01 REV. 4/81

ABB Environmental Services, Inc.

PROJECT	COMP. BY SWR	JOB NO. 700509
	CHK. BY SNP	DATE 3-14-94

Basin could be located between old and new Patton Road.

Proposed size = 50' X 200' X 4'

Estimate volume of water to drain.

Assume 50% pore vol in excavated material

(1,200 c.y.)(0.5) = 600 c.y. water (if 100% of water drains)

plus water in bucket

@ 15% 90 c.y.

690 c.y. = 139,352 gallons

DATA FILE FOR COLD SPRING BROOK 0–1 FOOT DEPTH CONCENTRATION CONTOURS
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS , MA

	ARSENIC					LEAD				
	0 FEET	2 FEET	3 FEET	4 FEET	5 FEET	0 FEET	2 FEET	3 FEET	4 FEET	5 FEET
CSD–92–01	82	18	6.3			570	49	3.5		
CSD–92–02	72	2.93		1.92		91	1.82		2.61	
CSD–92–03	18.1		12.4		6.84	17.8		2.83		3
CSD–92–04	16.4		5.2		2.85	6.49		2.58		2.9
CSD–92–05	4.15	1.73		1.97		4.36	2.31		3.2	
CSD–92–06	3.5	1.12		22		2.66	2.41		2.82	
CSD–92–07	390	910				31.2	1.63			
CSD–92–08	250	230				120	16			
CSD–92–09	250		135		3.92	33.3		17		3.34
CSD–92–10	3.78	7.5				2.77	2.64			
CSD–92–11	78	99				8.09	5.36			
CSD–92–12	20	22				6.4	6.64			
CSD–92–14	280					11.6				
CSD–92–15	11.9					7.7				
CSD–92–16	15					11.4				
CSB–SE–01	69					50.4				
CSB–SE–02	160					174				
CSB–SE–03	20					14.2				
CSB–SE–04	32					32				
CSB–SE–05	6.5					11.4				
CSB–SE–06	40					75.8				
CSB–SE–07	35					57.3				
CSB–SE–08	34					47.2				
CSB–SE–09	52					345				

Candidate PRGs

Ontario MOENOEL

	LOEL	6	31
	SOEL	33	250
NOAA	ER–L	33	35
	ER–M	85	110
	ER–S		

CSBLPLOT 15–Mar–94

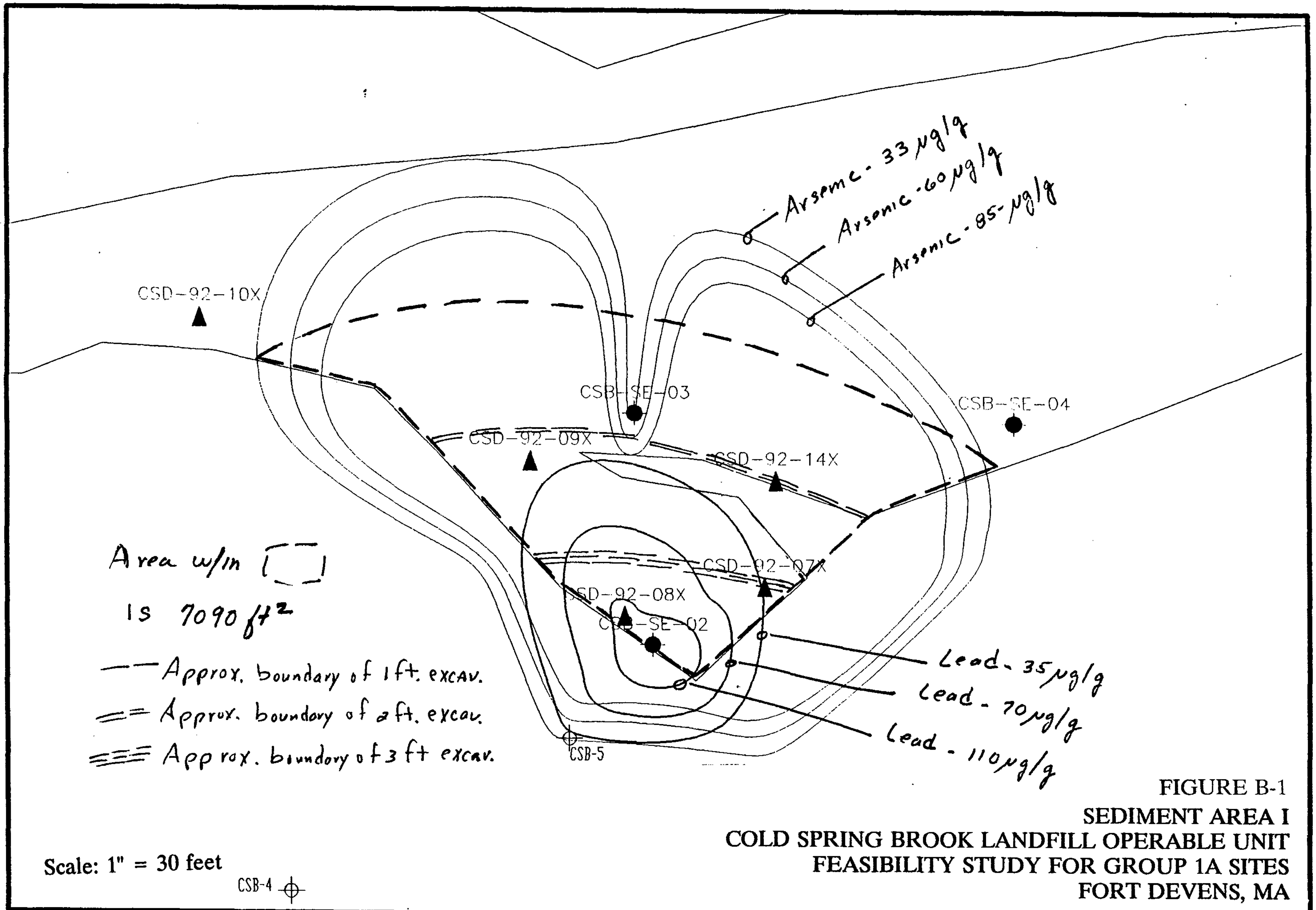


FIGURE B-1
SEDIMENT AREA I
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

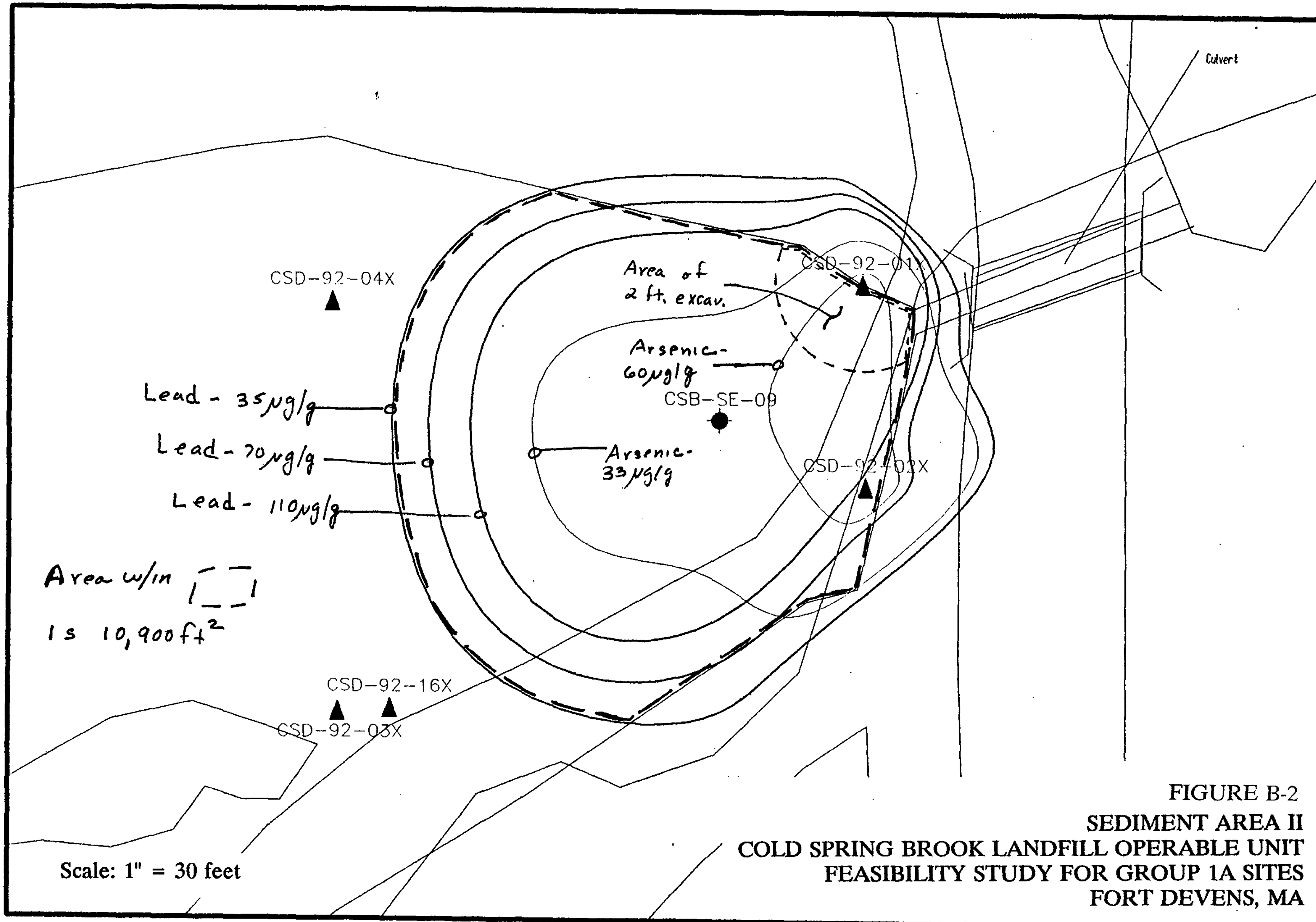


FIGURE B-2
SEDIMENT AREA II
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

APPENDIX C

DRUM REMOVAL COSTS

PROJECT Fort Devens Group 1A FS Drum removal	COMP. BY [illegible] CHK. BY SNP	JOB NO. 7005-07 DATE 9/10/93

14 Drums assumed to require removal

7 of these drums were observed and sampled by Union Carbide

3 drums observed empty
Disposal = 40\$/drum x 3 = \$120.00

2 drums w/contents below TCLP contaminant concentration limit
Overpack = 150\$/drum x 2 = \$300
Disposal (landfill) = 350\$/drum x 2 = \$700

2 drums w/contents may be above TCLP limit
Overpack = 150\$/drum x 2 = \$300
Disposal (incinerator) = 750\$/drum x 2 = \$1,500

Assume remaining 7 drums pass TCLP test
Disposal (landfill) = 350\$/drum x 7 = \$2,450

Total Disposal cost ~~\$15,370~~
\$5,370 SP

Assume will conduct TCLP tests on remaining 7 drums, because the 7 Union Carbide drums have already been sampled
\$1,400/drum x 7 = \$9,800

CleanHarbors
ENVIRONMENTAL SERVICES, INC.
238A CHERRY STREET • SHREWSBURY, MA 01545
(508) 842-0100 • FAX (508) 842-5818

September 10, 1993

ABB Environmental Services
P.O. Box 7050
110 Free Street
Portland, ME 04104

Attn: Lori Truesdale

Dear Lori:

The following are the cost estimates I have prepared based on my site visit to Fort Devens, MA. These costs address the sediment removal and drum removal at the Cold Spring Brook Pond.

1. Construction of access road and tree removal at culvert area - $12,000.00 (Area I).

2. Construction of access road and tree removal at landfill side of pond - $45,000.00 (Area II).

3. Excavation and transportation of sediment from Area I to sediment storage area - $18,000.00 (using clamshell bucket and crane).

4. Excavation and transportation of sediment from Area II to sediment storage area - $41,000.00 (using clamshell bucket and crane).

5. Construction of temporary sediment storage area with impervious liner. 10,000 sq. foot area with 4 foot dike walls to hold the wet sediment - $15,000.00.

6. T.C.L.P testing of soils - $1,400.00/sample
   " " of drums - $1,400.00/sample

7. Transportation disposal of RCRA hazardous soils and sludges for stabilization at a hazardous waste facility - $350.00/ton.

8. Transportation and disposal of non-hazardous soils and sludges for solid waste landfill disposal - $180.00/ton.

CleanHarbors

9. On site solidification of sediment sludge - $100.00/ton.

10. Disposal of RECRA waste drums for stabilization - $350.00/each.

    Disposal of RECRA waste drums for incineration - $750.00/each.

    Disposal of empty drums - $40.00/each.

11. Installation of curtain barrier in pond at Area I - $6,500.00.

12. Mobilization/demobilization cost for site equipment - $5,500.00 (frac tanks, excavators, crane, dump trailers etc.).

13. Drying agent will add to the sediment sludge disposal because of solidification process. Three-part wet sludge to one-part drying agent.

14. Excavation of drums, overpacking as needed or drum consolidation, construction of staging area, securing drums at staging area, manifesting, handling and off site to disposal outlet. Transportation drums - $6,000.00-$8,000.00 (does not include disposal costs or cost of overpack drums - $150.00/each).

The above pricing is based on the following assumptions:

1. Dewatering permits will be supplied by ABB.
2. Conservation Commission approval process will be completed by ABB.
3. The Army base will provide a staging area for the solidification process.
4. Prices do not include site restoration or replanting in access areas.
5. Prices based on using sand and gravel that is on site located across the street from the landfill.

Please contact me If you have any questions regarding this.

Regards,

Peter Joseph

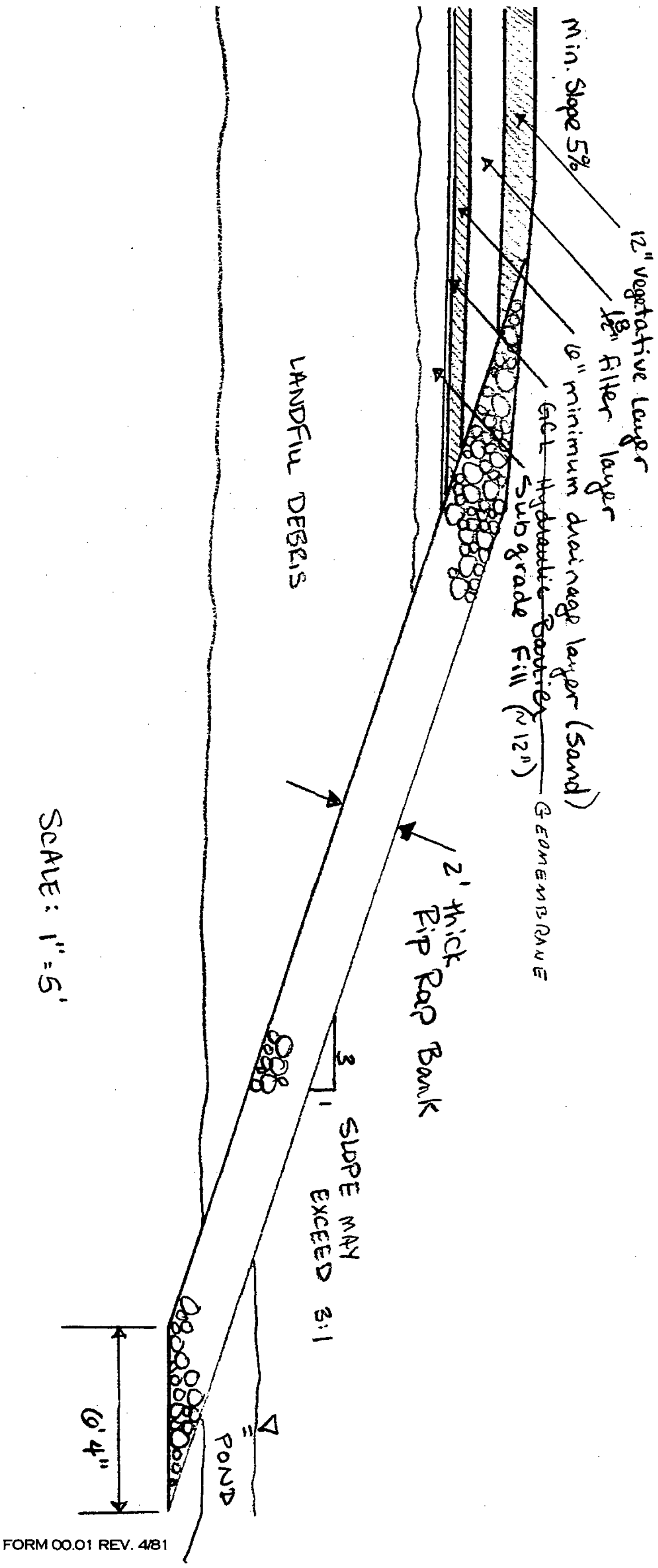
Peter Joseph
Field Services Manager

PDJ/cb

APPENDIX D

COLD SPRING BROOK LANDFILL
COVER SYSTEM QUANTITIES

PROJECT	COMP. BY	JOB NO.
Fort Devens Group 1A FS Cold Spring Brook Cover System Quantities	SNP	07005-04
	CHK. BY	DATE
	SWR	2-18-94



PROJECT	COMP. BY	JOB NO.
Fort Devens Group 1A FS Cold Spring Brook Cover System Quantities	SNP	07005-04
	CHK. BY	DATE 2-18-94

· Approximate aerial extent of landfill is 4 acres
Cut and fill to achieve a maximum side slope 3:1 and a minimum top slope of 5%
Assume Riprap along Northern edge of landfill, and liner plus cover layers extend past the cap boundaries on remaining sides ~12'

western edge

$12' \times 160' = 1920\ ft^2$

eastern edge

$12' \times 280' = 3360\ ft^2$

southern edge

$12' \times 920' = \underline{11{,}040\ ft^2}$

$16{,}320\ ft^2 \approx 0.4$ acres

Therefore, use 4.4 acres for extent of cover system

Cover System Quantities:

12" Vegetative Layer ⇒ $1' \times 191{,}664\ ft^2 \simeq 7100\ yd^3$

~~12~~ 18" filter layer ⇒ $1' \times 191{,}664\ ft^2 \simeq$ ~~7100~~ 10,650 yd^3

6" Sand drainage layer ⇒ $0.5 \times 191{,}664 \simeq 3550\ yd^3$

~~GCL Hydraulic layer~~ GEOMEMBRANE ⇒ $\simeq 192{,}000\ ft^2$

Subgrade Fill ⇒ $1' \times 191{,}664\ ft^2 \simeq 7100\ yd^3$

Rip Rap Quantity:

Northern Edge of landfill ~ 960'

Riprap ⇒ $2' \times 31.6' \times 960' \simeq 2250\ yd^3$

(Assumes ≈ 2:1 Slope)

APPENDIX E

COST ESTIMATE FOR CONSOLIDATION FACILITY

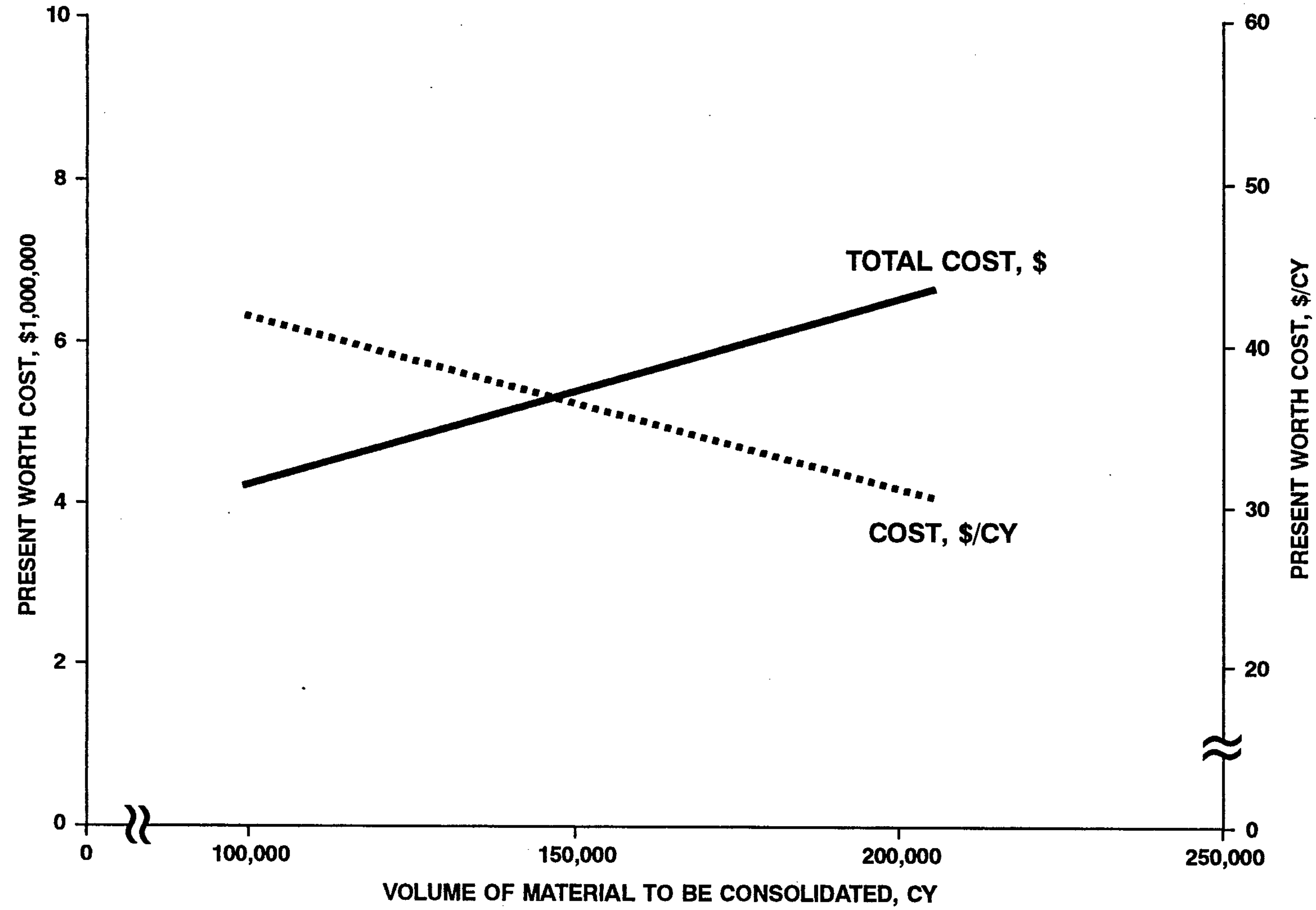


FIGURE E-1
CONSOLIDATION LANDFILL COSTS VERSUS VOLUME
COLD SPRING BROOK LANDFILL OPERABLE UNIT
FEASIBILITY STUDY FOR GROUP 1A SITES
FORT DEVENS, MA

W9412007D

ABB Environmental Services, Inc.

TABLE E-1
COST SUMMARY TABLE
CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Site preparation and mobilization	$	226,000
New landfill construction		1,942,000
TOTAL DIRECT COST OF CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	2,168,000
INDIRECT COST OF CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Health and Safety @ 5% of Total Direct Cost	$	108,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		108,000
Engineering @ 10% of Total Direct Cost		217,000
Services During Construction @ 10% of Total Direct Cost		217,000
TOTAL INDIRECT COST OF CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	650,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	2,818,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating & Maintenance Costs for New Landfill	$	110,000
Total Present Worth of O&M Costs @ 7% for 30 Years	$	1,365,000
TOTAL PRESENT WORTH OF O&M COSTS	$	1,365,000
TOTAL COST OF CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	4,183,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E1: CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
COST SUMMARY TABLE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY				
SITE PREPARATION AND MOBILIZATION				$226,000
NEW LANDFILL CONSTRUCTION				1,942,000
TOTAL DIRECT COST OF APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY				$2,168,000
INDIRECT COST OF APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY				
HEALTH AND SAFETY			5.00%	$108,000
LEGAL, ADMIN, PERMITTING			5.00%	108,000
ENGINEERING			10.00%	217,000
SERVICES DURING CONSTRUCTION			10.00%	217,000
TOTAL DIRECT COST OF APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY				$650,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$2,818,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS FOR NEW LANDFILL				$110,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$1,365,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$1,365,000
TOTAL COST OF APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY				$4,183,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E1: CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
NEW LANDFILL MATERIALS STOCKPILE AREA				
CLEAR & GRUB LIGHT VEGETATION	1	AC	3825.00	$3,825
GRADE	1600	CY	2.00	3,200
GRAVEL - 12" THICK	4840	SY	3.50	16,940
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	4	EA	1000.00	4,000
OFFICE TRAILER	4	MON	150.00	600
STORAGE TRAILER	4	MON	150.00	600
TOILET - 2 EA	34	WK	25.00	850
WATER COOLER - 2 EA	34	WK	25.00	850
WATER	170	DAY	15.00	2,550
TELEPHONE SERVICE	4	MON	500.00	2,000
ELECTRICITY	4	MON	250.00	1,000
PICK-UP (2 EA)	8	MON	1000.00	8,000
OFFICE EQUIPMENT	4	MON	1000.00	4,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (4 MON*210HR/MON)	840	MNHR	60.00	50,400
FOREMAN (4 MON*210HR/MON)	840	MNHR	50.00	42,000
CLERK/TYPIST (4 MON*168HR/MON)	672	MNHR	25.00	16,800
UNDEVELOPED DESIGN DETAILS ~25%				45,365
TOTAL SITE PREPARATION AND MOBILIZATION				$226,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E1: CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY

NEW LANDFILL CONSTRUCTION DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
TOPOGRAPHIC SURVEY, 14 ACRE PRE-DESIGN, 8 ACRE AS-BUILT	1	LS	10000.00	$10,000
CLEAR & GRUB SITE STOCKPILE AREA	3	AC	3825.00	11,475
CLEAR & GRUB SITE	8	AC	3825.00	30,600
GRADE SITE	40000	CY	1.30	52,000
STOCKPILE GRADED MATERIAL	33300	CY	3.75	124,875
CLAY	14700	CY	12.50	183,750
60 MIL HDPE GEOMEMBRANE LINER	198000	SF	0.60	118,800
10-2 SAND DRAINAGE LAYER	7300	CY	14.00	102,200
GEOTEXTILE	198000	SF	0.10	19,800
10-3 SAND BUFFER LAYER, FROM STOCKPILE	3700	CY	7.00	25,900
LEACHATE COLLECTION PIPE - 6" SCH 80 PERFORATED HDPE	3700	LF	15.00	55,500
SPREAD & COMPACT WASTE	100000	CY	1.80	180,000
DAILY COVER, FROM STOCKPILE	10000	CY	7.00	70,000
10-3 GAS VENTING LAYER, FROM STOCKPILE	8100	CY	7.00	56,700
60 MIL VLDPE GEOMEMBRANE COVER	219000	SF	0.60	131,400
10-3 SAND DRAINAGE LAYER	4100	CY	10.00	41,000
FILTER FABRIC	219000	SF	0.10	21,900
FILTER/PROTECTION LAYER, FROM STOCKPIL	12200	CY	7.00	85,400
VEGETATIVE SUPPORT MATERIAL, FROM STOCKPILE	8100	CY	7.00	56,700
GAS VENT RISERS	3	EA	500.00	1,500
SEED, FERTILIZE, MULCH	8	AC	2000.00	16,000
LEACHATE STORAGE TANK, 5000 GAL	1	LS	10000.00	10,000
LEACHATE PIPING	100	LF	15.00	1,500
FENCE	2350	LF	15.00	35,250
GATE, 10' WIDE	2	EA	300.00	600
WARNING SIGNS	47	EA	50.00	2,350
MONITORING WELLS, 4", 70' DEEP	6	EA	5500.00	33,000
TREATMENT OF PRECIPITATION/LEACHATE DURING CONSTRUCTION	4	MON	18800.00	75,200
UNDEVELOPED DESIGN DETAILS ~25%				388,600
TOTAL NEW LANDFILL CONSTRUCTION				$1,942,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E1: CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E1 - CONSTRUCTION OF 100,000 CY SOLID WASTE CONSOLIDATION FACILITY
ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
MONITORING GROUNDWATER BACKGROUND				
SAMPLING AT 6 WELLS + QA/QC	4	EVENT	2200.00	$8,800
ANALYSIS	32	SMPL	1200.00	38,400
O&M COSTS OCCURING OVER THIRTY YEARS				
GROUNDWATER SAMPLING, 6 WELLS, SEMI-ANNUALLY	2	EVENT	2200.00	4,400
GROUNDWATER SAMPLE ANALYSIS 6 SAMPLES + 2 QA/QC EQUIVALENT, SEMI-ANNUALLY, VOCs, INORGANICS, WATER QUALITY PARAMETERS	16	SMPL	1200.00	19,200
LANDFILL GAS MONITORING 6 POINTS QUARTERLY PLUS ANALYSIS	4	EVENT	1875.00	7,500
GROUNDWATER MONITORING & GAS COLLECTION SYSTEM MAINTENANCE				
LABORER	8	MNHR	30.00	240
MATERIALS	1	LS	300.00	300
LANDFILL COVER MAINTENANCE				
INSPECTION - 2 MEN @ 1 DAY/MAN	16	MNHR	75.00	1,200
GENERAL REPAIR				
DUMP TRUCK & DRIVER	1	DAY	665.00	665
FRONT END LOADER & OPERATO	1	DAY	800.00	800
LABORER - 2 EA	16	MNHR	30.00	480
MATERIALS	1	LS	500.00	500
MOWING - TRACTOR & OPERATOR	1	DAY	500.00	500
TRANSPORT OF LEACHATE, 2000 GAL/LD	34	LOAD	100.00	3,400
AYER WWTF USER FEE	94	CCF	2.00	188
BIENNIAL REPORT TO DEP - ANNUALIZED	0.4831	LS	2500.00	1,208
UNDEVELOPED DESIGN DETAILS ~25%				22,219
TOTAL ANNUAL O&M COSTS FOR 30 YEAR ACTIVITIES				$110,000

TABLE E-2
COST SUMMARY TABLE
CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Site preparation and mobilization	$	307,000
New landfill construction		2,702,000
TOTAL DIRECT COST OF CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	3,009,000
INDIRECT COST OF CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Health and Safety @ 5% of Total Direct Cost	$	150,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		150,000
Engineering @ 10% of Total Direct Cost		301,000
Services During Construction @ 10% of Total Direct Cost		301,000
TOTAL INDIRECT COST OF CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	902,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	3,911,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating & Maintenance Costs for New Landfill	$	111,000
Total Present Worth of O&M Costs @ 7% for 30 Years	$	1,377,000
TOTAL PRESENT WORTH OF O&M COSTS	$	1,377,000
TOTAL COST OF CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	5,288,000

APPENDIX E

PROJECT:	FEASIBILITY STUDY FOR GROUP 1A SITES APPENDIX E2: CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY	JOB #	7005-04
LOCATION:	COLD SPRING BROOK LANDFILL OPERABLE UNIT FT. DEVENS, MASSACHUSETTS	DATE	02-Dec-94
ENGINEER:	ABB ENVIRONMENTAL SERVICES, INC.		
ESTIMATOR:	P. R. MARTIN		

APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY

COST SUMMARY TABLE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY				
SITE PREPARATION AND MOBILIZATION				$307,000
NEW LANDFILL CONSTRUCTION				2,702,000
TOTAL DIRECT COST OF APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY				$3,009,000
INDIRECT COST OF APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY				
HEALTH AND SAFETY			5.00%	$150,000
LEGAL, ADMIN, PERMITTING			5.00%	150,000
ENGINEERING			10.00%	301,000
SERVICES DURING CONSTRUCTION			10.00%	301,000
TOTAL DIRECT COST OF APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY				$902,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$3,911,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS FOR NEW LANDFILL				$111,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$1,377,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$1,377,000
TOTAL COST OF APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY				$5,288,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E2: CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
NEW LANDFILL MATERIALS STOCKPILE AREA				
CLEAR & GRUB LIGHT VEGETATION	1	AC	3825.00	$3,825
GRADE	1600	CY	2.00	3,200
GRAVEL - 12" THICK	4840	SY	3.50	16,940
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	4	EA	1000.00	4,000
OFFICE TRAILER	6	MON	150.00	900
STORAGE TRAILER	6	MON	150.00	900
TOILET - 2 EA	52	WK	25.00	1,300
WATER COOLER - 2 EA	52	WK	25.00	1,300
WATER	260	DAY	15.00	3,900
TELEPHONE SERVICE	6	MON	500.00	3,000
ELECTRICITY	6	MON	250.00	1,500
PICK-UP (2 EA)	12	MON	1000.00	12,000
OFFICE EQUIPMENT	6	MON	1000.00	6,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (6 MON*210HR/MON)	1260	MNHR	60.00	75,600
FOREMAN (6 MON*210HR/MON)	1260	MNHR	50.00	63,000
CLERK/TYPIST (6 MON*168HR/MON)	1008	MNHR	25.00	25,200
UNDEVELOPED DESIGN DETAILS ~25%				61,415
TOTAL SITE PREPARATION AND MOBILIZATION				$307,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E2: CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT, FT. DEVENS, MASSACHUSETTS — DATE 02-Dec-94

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY

NEW LANDFILL CONSTRUCTION DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
TOPOGRAPHIC SURVEY, 16 ACRE PRE-DESIGN, 10 ACRE AS-BUILT	1	LS	12000.00	$12,000
CLEAR & GRUB SITE STOCKPILE AREA	5	AC	3825.00	19,125
CLEAR & GRUB SITE	10	AC	3825.00	38,250
GRADE SITE	55000	CY	1.30	71,500
STOCKPILE GRADED MATERIAL	46000	CY	3.75	172,500
CLAY	20500	CY	12.50	256,250
60 MIL HDPE GEOMEMBRANE LINER	277000	SF	0.60	166,200
10-2 SAND DRAINAGE LAYER	10300	CY	14.00	144,200
GEOTEXTILE	277000	SF	0.10	27,700
10-3 SAND BUFFER LAYER, FROM STOCKPILE	5100	CY	7.00	35,700
LEACHATE COLLECTION PIPE - 6" SCH 80 PERFORATED HDPE	5100	LF	15.00	76,500
SPREAD & COMPACT WASTE	150000	CY	1.80	270,000
DAILY COVER, FROM STOCKPILE	15000	CY	7.00	105,000
10-3 GAS VENTING LAYER, FROM STOCKPILE	11200	CY	7.00	78,400
60 MIL VLDPE GEOMEMBRANE COVER	303000	SF	0.60	181,800
10-3 SAND DRAINAGE LAYER	5600	CY	10.00	56,000
FILTER FABRIC	303000	SF	0.10	30,300
FILTER/PROTECTION LAYER, FROM STOCKPIL	16900	CY	7.00	118,300
VEGETATIVE SUPPORT MATERIAL, FROM STOCKPILE	11200	CY	7.00	78,400
GAS VENT RISERS	5	EA	500.00	2,500
SEED, FERTILIZE, MULCH	10	AC	2000.00	20,000
LEACHATE STORAGE TANK, 5000 GAL	1	LS	10000.00	10,000
LEACHATE PIPING	100	LF	15.00	1,500
FENCE	2700	LF	15.00	40,500
GATE, 10' WIDE	2	EA	300.00	600
WARNING SIGNS	54	EA	50.00	2,700
MONITORING WELLS, 4", 70' DEEP	6	EA	5500.00	33,000
TREATMENT OF PRECIPITATION/LEACHATE DURING CONSTRUCTION	6	MON	18800.00	112,800
UNDEVELOPED DESIGN DETAILS ~25%				540,275
TOTAL NEW LANDFILL CONSTRUCTION				$2,702,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E2: CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E2 - CONSTRUCTION OF 150,000 CY SOLID WASTE CONSOLIDATION FACILITY
ANNUAL O&M COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
MONITORING GROUNDWATER BACKGROUND				
SAMPLING AT 6 WELLS + QA/QC	4	EVENT	2200.00	$8,800
ANALYSIS	32	SMPL	1200.00	38,400
O&M COSTS OCCURING OVER THIRTY YEARS				
GROUNDWATER SAMPLING, 6 WELLS, SEMI-ANNUALLY	2	EVENT	2200.00	4,400
GROUNDWATER SAMPLE ANALYSIS 6 SAMPLES + 2 QA/QC EQUIVALENT, SEMI-ANNUALLY, VOCs, INORGANICS, WATER QUALITY PARAMETERS	16	SMPL	1200.00	19,200
LANDFILL GAS MONITORING 6 POINTS QUARTERLY PLUS ANALYSIS	4	EVENT	1875.00	7,500
GROUNDWATER MONITORING & GAS COLLECTION SYSTEM MAINTENANCE				
LABORER	8	MNHR	30.00	240
MATERIALS	1	LS	300.00	300
LANDFILL COVER MAINTENANCE				
INSPECTION - 2 MEN @ 1 DAY/MAN	16	MNHR	75.00	1,200
GENERAL REPAIR				
DUMP TRUCK & DRIVER	1	DAY	665.00	665
FRONT END LOADER & OPERATO	1	DAY	800.00	800
LABORER - 2 EA	16	MNHR	30.00	480
MATERIALS	1	LS	500.00	500
MOWING - TRACTOR & OPERATOR	1	DAY	500.00	500
TRANSPORT OF LEACHATE, 2000 GAL/LD	44	LOAD	100.00	4,400
AYER WWTF USER FEE	116	CCF	2.00	232
BIENNIAL REPORT TO DEP - ANNUALIZED	0.4831	LS	2500.00	1,208
UNDEVELOPED DESIGN DETAILS ~25%				22,175
TOTAL ANNUAL O&M COSTS FOR 30 YEAR ACTIVITIES				$111,000

TABLE E-3
COST SUMMARY TABLE
CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY

FEASIBILITY STUDY FOR GROUP 1A SITES
FT. DEVENS, MA

ITEM		TOTAL COST
DIRECT COST OF CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Site preparation and mobilization	$	388,000
New landfill construction		3,582,000
TOTAL DIRECT COST OF CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	3,970,000
INDIRECT COST OF CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY		
Health and Safety @ 5% of Total Direct Cost	$	199,000
Legal, Administration, Permitting @ 5% of Total Direct Cost		199,000
Engineering @ 10% of Total Direct Cost		397,000
Services During Construction @ 10% of Total Direct Cost		397,000
TOTAL INDIRECT COST OF CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	1,192,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST	$	5,162,000
OPERATING AND MAINTENANCE COSTS		
Total Annual Operating & Maintenance Costs for New Landfill	$	112,000
Total Present Worth of O&M Costs @ 7% for 30 Years	$	1,390,000
TOTAL PRESENT WORTH OF O&M COSTS	$	1,390,000
TOTAL COST OF CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY	$	6,552,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E3: CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY

LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS

ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY
COST SUMMARY TABLE

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
DIRECT COST OF APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY				
SITE PREPARATION AND MOBILIZATION				$388,000
NEW LANDFILL CONSTRUCTION				3,582,000
TOTAL DIRECT COST OF APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY				$3,970,000
INDIRECT COST OF APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY				
HEALTH AND SAFETY			5.00%	$199,000
LEGAL, ADMIN, PERMITTING			5.00%	199,000
ENGINEERING			10.00%	397,000
SERVICES DURING CONSTRUCTION			10.00%	397,000
TOTAL DIRECT COST OF APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY				$1,192,000
TOTAL CAPITAL (DIRECT + INDIRECT) COST				$5,162,000
OPERATING AND MAINTENANCE COSTS				
TOTAL ANNUAL O&M COSTS FOR NEW LANDFILL				$112,000
TOTAL PRESENT WORTH OF ANNUAL O&M COSTS (7% FOR THIRTY YEARS)				$1,390,000
TOTAL PRESENT WORTH OF OPERATING AND MAINTENANCE COSTS				$1,390,000
TOTAL COST OF APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY				$6,552,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES JOB # 7005-04
APPENDIX E3: CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY
SITE PREPARATION AND MOBILIZATION

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
SITE PREPARATION				
NEW LANDFILL MATERIALS STOCKPILE AREA				
CLEAR & GRUB LIGHT VEGETATION	1	AC	3825.00	$3,825
GRADE	1600	CY	2.00	3,200
GRAVEL - 12" THICK	4840	SY	3.50	16,940
MOBILIZATION				
EQUIPMENT (IN OR OUT)				
FRONT END LOADER	2	EA	500.00	1,000
DUMP TRUCK	6	EA	250.00	1,500
BACKHOE	2	EA	250.00	500
DOZER	4	EA	1000.00	4,000
OFFICE TRAILER	8	MON	150.00	1,200
STORAGE TRAILER	8	MON	150.00	1,200
TOILET - 2 EA	68	WK	25.00	1,700
WATER COOLER - 2 EA	68	WK	25.00	1,700
WATER	340	DAY	15.00	5,100
TELEPHONE SERVICE	8	MON	500.00	4,000
ELECTRICITY	8	MON	250.00	2,000
PICK-UP (2 EA)	16	MON	1000.00	16,000
OFFICE EQUIPMENT	8	MON	1000.00	8,000
PUMPS, TOOLS, MINOR EQUIPMENT	1	LS	2500.00	2,500
LABORER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	30.00	4,800
CARPENTER (2 MEN*10 DAY/MAN*8 HR/DAY)	160	MNHR	38.00	6,080
ELECTRICIAN (2 MEN*10 DAY/MAN*8 HR/DAY	160	MNHR	41.50	6,640
SITE SUPERINTENDANT (8 MON*210HR/MON)	1680	MNHR	60.00	100,800
FOREMAN (8 MON*210HR/MON)	1680	MNHR	50.00	84,000
CLERK/TYPIST (8 MON*168HR/MON)	1344	MNHR	25.00	33,600
UNDEVELOPED DESIGN DETAILS ~25%				77,715
TOTAL SITE PREPARATION AND MOBILIZATION				$388,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES — JOB # 7005-04
APPENDIX E3: CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT — DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY

NEW LANDFILL CONSTRUCTION DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
TOPOGRAPHIC SURVEY, 20 ACRE PRE-DESIGN, 12 ACRE AS-BUILT	1	LS	15000.00	$15,000
CLEAR & GRUB SITE STOCKPILE AREA	6	AC	3825.00	22,950
CLEAR & GRUB SITE	12	AC	3825.00	45,900
GRADE SITE	72500	CY	1.30	94,250
STOCKPILE GRADED MATERIAL	60100	CY	3.75	225,375
CLAY	27400	CY	12.50	342,500
60 MIL HDPE GEOMEMBRANE LINER	370000	SF	0.60	222,000
10-2 SAND DRAINAGE LAYER	13700	CY	14.00	191,800
GEOTEXTILE	370000	SF	0.10	37,000
10-3 SAND BUFFER LAYER, FROM STOCKPILE	6800	CY	7.00	47,600
LEACHATE COLLECTION PIPE - 6" SCH 80 PERFORATED HDPE	7100	LF	15.00	106,500
SPREAD & COMPACT WASTE	211000	CY	1.80	379,800
DAILY COVER, FROM STOCKPILE	21000	CY	7.00	147,000
10-3 GAS VENTING LAYER, FROM STOCKPILE	14800	CY	7.00	103,600
60 MIL VLDPE GEOMEMBRANE COVER	400000	SF	0.60	240,000
10-3 SAND DRAINAGE LAYER	7400	CY	10.00	74,000
FILTER FABRIC	400000	SF	0.10	40,000
FILTER/PROTECTION LAYER, FROM STOCKPIL	22200	CY	7.00	155,400
VEGETATIVE SUPPORT MATERIAL, FROM STOCKPILE	14800	CY	7.00	103,600
GAS VENT RISERS	7	EA	500.00	3,500
SEED, FERTILIZE, MULCH	12	AC	2000.00	24,000
LEACHATE STORAGE TANK, 5000 GAL	1	LS	10000.00	10,000
LEACHATE PIPING	100	LF	15.00	1,500
FENCE	3040	LF	15.00	45,600
GATE, 10' WIDE	2	EA	300.00	600
WARNING SIGNS	61	EA	50.00	3,050
MONITORING WELLS, 4", 70' DEEP	6	EA	5500.00	33,000
TREATMENT OF PRECIPITATION/LEACHATE DURING CONSTRUCTION	8	MON	18800.00	150,400
UNDEVELOPED DESIGN DETAILS ~25%				716,075
TOTAL NEW LANDFILL CONSTRUCTION				$3,582,000

APPENDIX E

PROJECT: FEASIBILITY STUDY FOR GROUP 1A SITES JOB # 7005-04
APPENDIX E3: CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY
LOCATION: COLD SPRING BROOK LANDFILL OPERABLE UNIT DATE 02-Dec-94
FT. DEVENS, MASSACHUSETTS
ENGINEER: ABB ENVIRONMENTAL SERVICES, INC.

ESTIMATOR: P. R. MARTIN

APPENDIX E3 - CONSTRUCTION OF 211,000 CY SOLID WASTE CONSOLIDATION FACILITY

ANNUAL O&M COSTS DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
MONITORING GROUNDWATER BACKGROUND				
SAMPLING AT 6 WELLS + QA/QC	4	EVENT	2200.00	$8,800
ANALYSIS	32	SMPL	1200.00	38,400
O&M COSTS OCCURING OVER THIRTY YEARS				
GROUNDWATER SAMPLING, 6 WELLS, SEMI-ANNUALLY	2	EVENT	2200.00	4,400
GROUNDWATER SAMPLE ANALYSIS 6 SAMPLES + 2 QA/QC EQUIVALENT, SEMI-ANNUALLY, VOCs, INORGANICS, WATER QUALITY PARAMETERS	16	SMPL	1200.00	19,200
LANDFILL GAS MONITORING 6 POINTS QUARTERLY PLUS ANALYSIS	4	EVENT	1875.00	7,500
GROUNDWATER MONITORING & GAS COLLECTION SYSTEM MAINTENANCE				
LABORER	8	MNHR	30.00	240
MATERIALS	1	LS	300.00	300
LANDFILL COVER MAINTENANCE				
INSPECTION - 2 MEN @ 1 DAY/MAN	16	MNHR	75.00	1,200
GENERAL REPAIR				
DUMP TRUCK & DRIVER	1	DAY	665.00	665
FRONT END LOADER & OPERATO	1	DAY	800.00	800
LABORER - 2 EA	16	MNHR	30.00	480
MATERIALS	1	LS	500.00	500
MOWING - TRACTOR & OPERATOR	1	DAY	500.00	500
TRANSPORT OF LEACHATE, 2000 GAL/LD	52	LOAD	100.00	5,200
AYER WWTF USER FEE	140	CCF	2.00	280
BIENNIAL REPORT TO DEP - ANNUALIZED	0.4831	LS	2500.00	1,208
UNDEVELOPED DESIGN DETAILS ~25%				22,327
TOTAL ANNUAL O&M COSTS FOR 30 YEAR ACTIVITIES				$112,000

APPENDIX F

QUANTITY CALCULATIONS FOR CONSOLIDATION FACILITY

Prepared by SWR Date 12-2-94

Checked by ____________ Date ____________

SOLID WASTE CONSOLIDATION FACILITY
VOLUME ESTIMATE

Consolidation facility will receive solid waste from the following existing locations at Fort Devens.

SA/AOC	Name		Vol.
SA 9	Landfill No. 5, North Post Landfill		56,000 c.y.
AOC 11	Landfill No. 7, Lovell Street Landfill		34,470 c.y.
AOC 40	Cold Spring Brook Landfill		100,000 c.y.
SA 6	Landfill No. 2, South Post		500 c.y.
SA 12	Landfill No. 8, Range Control Landfill		8,700 c.y.
SA 13	Landfill No. 9, Lake George Street Landfill		10,000 c.y.
AOC 41	Unauthorized Dumping Area A		1,240 c.y.
	SOLID WASTE TOTAL		210,910 c.y.
	Daily cover @	0.1	21,091 c.y.
	TOTAL LANDFILL VOLUME		232,001 c.y.

NOTES:
Volume for AOC 11 from A.D. Little
Estmate daily cover requirement at 10 percent

100,000 cy SOLID WASTE CONSOLIDATION FACILITY
CALCULATE LANDFILL CELL VOLUME FOR GIVEN DIMENSIONS

Assumptions for rectangular landfill cell:
- Increase volume 10% for daily cover
- Landfill cell is rectangular
- Depth of waste at edge of landfill box = H
- Width of side of "box" with depth H = L
- Length of side of "box" with depth H = 2L
- Mimimum top slope = X/100 ft., four sides
- Minimum bottom slope = Y/100 ft., two sides
- Side slope = 3:1

Formula to calculate volume of a rectanglar landfill cell if L and H are known, and cell has 3:1 bottom side slope mirroring landfill upper surface:

Vol = (H*2L*L) + (2*H/2*3H/2*L) + (2*H/2*3H/2*2L) + (3*H*H*H) + (10/24)(X*L*L*L) + (0.50*Y*L*L*L
Vol = (H*2L*L) +(3/2)(H*H*L) + (3*H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)
Vol = (H*2L*L) +(4.5)(H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)

Let H =	14	ft.	Vol =	2,986,295	c.f.
Let L =	274	ft.		110,604	c.y.
Let X =	5	ft./100 ft			
Let Y =	2	ft./100 ft			

Optimize cut and fill for edge berm, basin, and material stockpile

Assumptions:
- Hc = depth of cut
- Hf = Depth of fill (i.e., height of berm above native surface).
- Hc + Hf = H/2
- DOES NOT CONSIDER VOLUME OF MATERIAL IN LINER SYSTEM

Formula for rectangular basin:

Vol cut = (2L*L*Hc) + (2L*Hc*3Hc) + (L*Hc*3Hc) + 12*Hc*Hc*Hc + 0.50*Y*L*L*L
Vol cut = (2L*L*Hc) + (9L*Hc*Hc) + (12*Hc*Hc*Hc) + (0.50*Y*L*L*L)

Vol fill = (2*L*3Hf*Hf) + (2*2L*3Hf*Hf) + (4*1/2*Hf*6Hf*6Hf)
Vol fill = (18L*Hf*Hf) + (72*Hf*Hf*Hf)

From above, if H =			14	ft.
and L =			274	ft.
if Hc =	1.2 ft.	Hf =	5.8	ft.
		Vol cut =	14,425	cy
		Vol fill =	6,665	cy
	Footprint:	Lc =	351	ft
		Wc =	625	ft

Prepared by SCWR Date 12-2-94

Checked by ____________ Date ____________

SOLID WASTE CONSOLIDATION FACILITY
CONSTRUCTION OF CONSOLIDATION FACILITY--QUANTITIES

ASSUMPTIONS
Required landfill volume is circa 110,000 c.y.
Estimates based on construction at level "greenfield" site

MATERIALS/QUANTITIES

Clear and grub, footprint plus 100 ft. all around				7.5 ac.
Rough grade construction area, footprint plus 100 ft. all around				7.5 ac.
Groundwater protection system				
Calculation assumptions				
Length of base =	L =	274	ft.	
Width of base =	W =	548	ft.	
Height of 3:1 sideslope =	Hs =	7	ft.	
Add 3% to horizontal dimensions for seaming and edge anchor				
	L' =	325		
	W' =	608		
Clay layer, k = 1E−7		24	in.	14,651 c.y.
Geomembrane		n.a.		197,794 s.f.
Drainage layer, k = 1E−2		12	in.	7,326 c.y.
Geotextile		n.a.		197,794 s.f.
Protection layer, k = 1E−3		6	in.	3,663 c.y.**
Leachate piping, 50 ft centers over base area plus manifold and 150 ft. run to sump				3,700 l.f.
Final cover system				
Assumed dimensions	Lc =	351	ft.	
(footprint)	Wc =	625	ft.	
Gas vent layer, k = 1 E−3		12	in.	8,125 c.y.**
Geomembrane		n.a.		219,375 s.f.
Drainage layer, k = 1E−3		6	in.	4,063 c.y.
Geotextile		n.a.		219,375 s.f.
Filter/protection layer		18	in.	12,188 c.y.**
Vegetative support layer		12	in.	8,125 c.y.**
Excavation/earth work				
Volume cut for basin		14400	c.y.	
Volume cut for GW Prot. Sys.		25640	c.y.	
Approx. cut		40040	c.y.	
Volume fill for berm		6700	c.y.	
Volume to stockpile		33340	c.y.	
Volume from stockpile**		32100	c.y.	
Volume spread (or add. cut if neg.)		1240	c.y.	
Gas vent risers, 1 per acre over base area				3 ea.
Gas vent piping, 208 ft. centers (416 ft./ acre)				1,434 l.f.
Fertilize, seed, mulch: footprint plus 100 ft. all around				7.5 ac.
Fence, circa 50 ft outside of footprint				2,352 ft.
Warning signs				47

150,000 cy SOLID WASTE CONSOLIDATION FACILITY
CALCULATE LANDFILL CELL VOLUME FOR GIVEN DIMENSIONS

Assumptions for rectangular landfill cell:
- Increase volume 10% for daily cover
- Landfill cell is rectangular
- Depth of waste at edge of landfill box = H
- Width of side of "box" with depth H = L
- Length of side of "box" with depth H = 2L
- Mimimum top slope = X/100 ft., four sides
- Minimum bottom slope = Y/100 ft., two sides
- Side slope = 3:1

Formula to calculate volume of a rectanglar landfill cell if L and H are known, and cell has 3:1 bottom side slope mirroring landfill upper surface:

Vol = (H*2L*L) + (2*H/2*3H/2*L) + (2*H/2*3H/2*2L) + (3*H*H*H) + (10/24)(X*L*L*L) + (0.50*Y*L*L*L
Vol = (H*2L*L) +(3/2)(H*H*L) + (3*H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)
Vol = (H*2L*L) +(4.5)(H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)

Let H =	14	ft.
Let L =	330	ft.
Let X =	5	ft./100 ft
Let Y =	2	ft./100 ft

Vol = 4,456,550 c.f.
165,057 c.y.

Optimize cut and fill for edge berm, basin, and material stockpile

Assumptions:
- Hc = depth of cut
- Hf = Depth of fill (i.e., height of berm above native surface).
- Hc + Hf = H/2
- DOES NOT CONSIDER VOLUME OF MATERIAL IN LINER SYSTEM

Formula for rectangular basin:

Vol cut = (2L*L*Hc) + (2L*Hc*3Hc) + (L*Hc*3Hc) + 12*Hc*Hc*Hc + 0.50*Y*L*L*L
Vol cut = (2L*L*Hc) + (9L*Hc*Hc) + (12*Hc*Hc*Hc) + (0.50*Y*L*L*L)

Vol fill = (2*L*3Hf*Hf) + (2*2L*3Hf*Hf) + (4*1/2*Hf*6Hf*6Hf)
Vol fill = (18L*Hf*Hf) + (72*Hf*Hf*Hf)

From above, if H =			14 ft.
and L =			330 ft.
if Hc =	0.7 ft.	Hf =	6.3 ft.
		Vol cut =	19,011 cy
		Vol fill =	9,399 cy
	Footprint:	Lc =	410 ft
		Wc =	740 ft

Prepared by SWR Date 12-2-94

Checked by ______ Date ______

SOLID WASTE CONSOLIDATION FACILITY
CONSTRUCTION OF CONSOLIDATION FACILITY--QUANTITIES

ASSUMPTIONS
Required landfill volume is circa 165,000 c.y.
Estimates based on construction at level "greenfield" site

MATERIALS/QUANTITIES

Clear and grub, footprint plus 100 ft. all around			9.8 ac.
Rough grade construction area, footprint plus 100 ft. all around			9.8 ac.
Groundwater protection system			
Calculation assumptions			
Length of base =	L =	330 ft.	
Width of base =	W =	660 ft.	
Height of 3:1 sideslope =	Hs =	7 ft.	
Add 3% to horizontal dimensions for seaming and edge anchor			
	L' =	383	
	W' =	723	
Clay layer, k = 1E−7		24 in.	20,522 c.y.
Geomembrane		n.a.	277,048 s.f.
Drainage layer, k = 1E−2		12 in.	10,261 c.y.
Geotextile		n.a.	277,048 s.f.
Protection layer, k = 1E−3		6 in.	5,131 c.y.**
Leachate piping, 50 ft centers over base area plus manifold and 150 ft. run to sump			5,100 l.f.
Final cover system			
Assumed dimensions (footprint)	Lc =	410 ft.	
	Wc =	740 ft.	
Gas vent layer, k = 1 E−3		12 in.	11,237 c.y.**
Geomembrane		n.a.	303,400 s.f.
Drainage layer, k = 1E−3		6 in.	5,619 c.y.
Geotextile		n.a.	303,400 s.f.
Filter/protection layer		18 in.	16,856 c.y.**
Vegetative support layer		12 in.	11,237 c.y.**
Excavation/earth work			
Volume cut for basin		19000 c.y.	
Volume cut for GW Prot. Sys.		35914 c.y.	
Approx. cut		54914 c.y.	
Volume fill for berm		9400 c.y.	
Volume to stockpile		45514 c.y.	
Volume from stockpile**		44460 c.y.	
Volume spread (or add. cut if neg.)		1053 c.y.	
Gas vent risers, 1 per acre over base area			5 ea.
Gas vent piping, 208 ft. centers (416 ft./acre)			2,080 l.f.
Fertilize, seed, mulch: footprint plus 100 ft. all around			9.8 ac.
Fence, circa 50 ft outside of footprint			2,700 ft.
Warning signs			54

211,000 cy SOLID WASTE CONSOLIDATION FACILITY
CALCULATE LANDFILL CELL VOLUME FOR GIVEN DIMENSIONS

Assumptions for rectangular landfill cell:

- Increase volume 10% for daily cover
- Landfill cell is rectangular
- Depth of waste at edge of landfill box = H
- Width of side of "box" with depth H = L
- Length of side of "box" with depth H = 2L
- Mimimum top slope = X/100 ft., four sides
- Minimum bottom slope = Y/100 ft., two sides
- Side slope = 3:1

Formula to calculate volume of a rectanglar landfill cell if L and H are known, and cell has 3:1 bottom side slope mirroring landfill upper surface:

Vol = (H*2L*L) + (2*H/2*3H/2*L) + (2*H/2*3H/2*2L) + (3*H*H*H) + (10/24)(X*L*L*L) + (0.50*Y*L*L*L
Vol = (H*2L*L) +(3/2)(H*H*L) + (3*H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)
Vol = (H*2L*L) +(4.5)(H*H*L) + 3*H*H*H + (10/24)(X*L*L*L) + (0.50*Y*L*L*L)

Let H =	14	ft.
Let L =	386	ft.
Let X =	5	ft./100 ft
Let Y =	2	ft./100 ft

Vol = 6,293,873 c.f.
233,106 c.y.

Optimize cut and fill for edge berm, basin, and material stockpile

Assumptions:

- Hc = depth of cut
- Hf = Depth of fill (i.e., height of berm above native surface).
- Hc + Hf = H/2
- DOES NOT CONSIDER VOLUME OF MATERIAL IN LINER SYSTEM

Formula for rectangular basin:

Vol cut = (2L*L*Hc) + (2L*Hc*3Hc) + (L*Hc*3Hc) + 12*Hc*Hc*Hc + 0.50*Y*L*L*L
Vol cut = (2L*L*Hc) + (9L*Hc*Hc) + (12*Hc*Hc*Hc) + (0.50*Y*L*L*L)

Vol fill = (2*L*3Hf*Hf) + (2*2L*3Hf*Hf) + (4*1/2*Hf*6Hf*6Hf)
Vol fill = (18L*Hf*Hf) + (72*Hf*Hf*Hf)

From above, if H =			14 ft.
and L =			386 ft.
if Hc =	0.3 ft.	Hf =	6.7 ft.
		Vol cut =	24,624 cy
		Vol fill =	12,354 cy
	Footprint:	Lc =	468 ft
		Wc =	854 ft

Prepared by SWR Date 12-2-94

Checked by ________ Date ________

SOLID WASTE CONSOLIDATION FACILITY
CONSTRUCTION OF CONSOLIDATION FACILITY--QUANTITIES

ASSUMPTIONS
Required landfill volume is circa 232,000 c.y.
Estimates based on construction at level "greenfield" site

MATERIALS/QUANTITIES

Clear and grub, footprint plus 100 ft. all around			12.4 ac.
Rough grade construction area, footprint plus 100 ft. all around			12.4 ac.
Groundwater protection system			
Calculation assumptions			
Length of base =	L =	386 ft.	
Width of base =	W =	772 ft.	
Height of 3:1 sideslope =	Hs =	7 ft.	
Add 3% to horizontal dimensions for seaming and edge anchor			
	L' =	441	
	W' =	838	
Clay layer, k = 1E-7		24 in.	27,378 c.y.
Geomembrane		n.a.	369,609 s.f.
Drainage layer, k = 1E-2		12 in.	13,689 c.y.
Geotextile		n.a.	369,609 s.f.
Protection layer, k = 1E-3		6 in.	6,845 c.y.**
Leachate piping, 50 ft centers over base area plus manifold and 150 ft. run to sump			7,100 l.f.
Final cover system			
Assumed dimensions	Lc =	468 ft.	
(footprint)	Wc =	854 ft.	
Gas vent layer, k = 1 E-3		12 in.	14,803 c.y.**
Geomembrane		n.a.	399,672 s.f.
Drainage layer, k = 1E-3		6 in.	7,401 c.y.
Geotextile		n.a.	399,672 s.f.
Filter/protection layer		18 in.	22,204 c.y.**
Vegetative support layer		12 in.	14,803 c.y.**
Excavation/earth work			
Volume cut for basin		24600 c.y.	
Volume cut for GW Prot. Sys.		47912 c.y.	
Approx. cut		72512 c.y.	
Volume fill for berm		12400 c.y.	
Volume to stockpile		60112 c.y.	
Volume from stockpile**		58654 c.y.	
Volume spread (or add. cut if neg.)		1458 c.y.	
Gas vent risers, 1 per acre over base area			7 ea.
Gas vent piping, 208 ft. centers (416 ft./acre)			2,846 l.f.
Fertilize, seed, mulch: footprint plus 100 ft. all around			12.4 ac.
Fence, circa 50 ft outside of footprint			3,044 ft.
Warning signs			61

5

PROJECT	COMP. BY	JOB NO.
Fort Devens Group 1A FS Leachate Collection	[illegible]	7005-04
	CHK. BY	DATE
	RKK	10/25/93

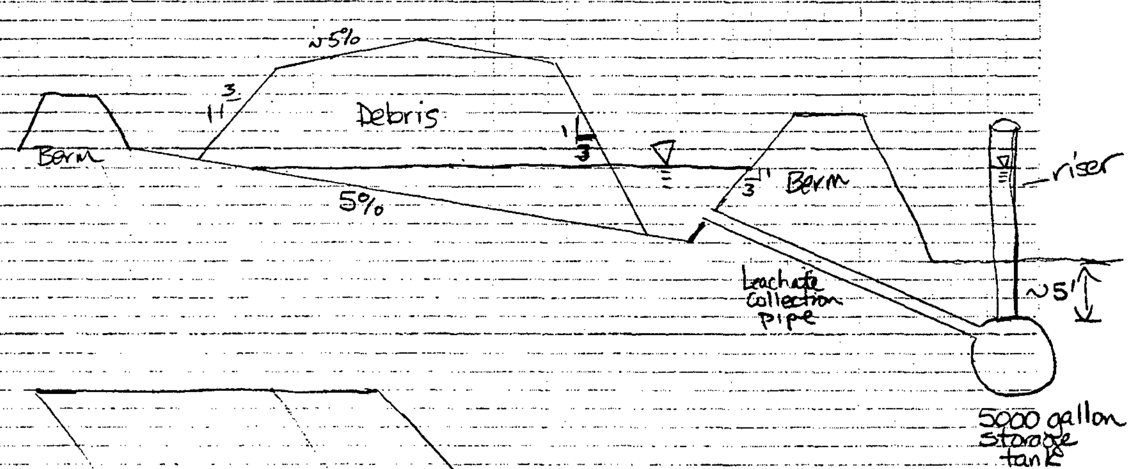
Assumptions: New solid waste landfill (12 Acres) open for one construction season, and will only collect storm water for that one season

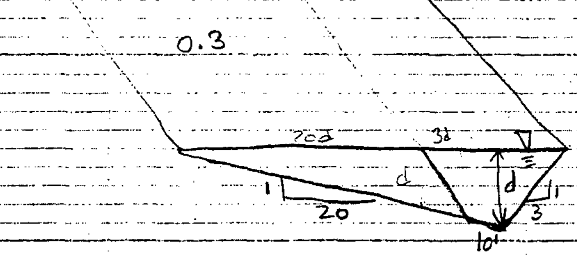
A 5000 gallon underground storage tank with leak detection would be installed.

Berms surrounding landfill would be constructed to hold a 25 year 24 hour storm within the landfill, while storm water from tank is pumped to the Ayer WWTP

Conservative stormwater volume estimate assumes CN = 100. Actually there would be some evaporation, and absorption of water by debris.

Conservative landfill storage volume assumes a 5% slope across bottom liner and an average porosity for the landfill of 0.3





PROJECT	COMP. BY	JOB NO.
Fort Devens Group 1A FS Leachate collection and storage	[illegible] CHK. BY SNP	7005-04 DATE 10/25/93

$$V = \tfrac{1}{2}d(6d+20)(500) + \tfrac{1}{2}(20d)(d)(0.3)(500)$$
$$= 1500d^2 + 5000d + 1500d^2$$
$$= 3000d^2 + 5000d$$

For a 25yr, 24 hour storm (~5.5-inches)
Storage volume required = (5.5 inches)(12 Acres)(100%)
$V = 239{,}580$ CF

$$239{,}580 \text{ CF} = 3000d^2 + 5000d$$
$$3000d^2 + 5000d - 239{,}580 = 0$$

Solution for quadratic eqn: $\dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

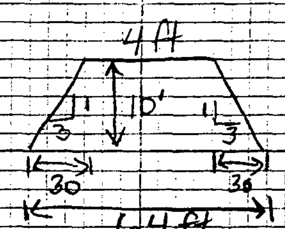
$a = 3000$
$b = 5000$
$c = -239{,}580$

$$\frac{-5000 \pm \sqrt{(5000)^2 - 4(3000)(-239{,}580)}}{2(3000)}$$

$d = 8.14$ feet

A berm on the downgradient slope of the landfill liner should be ~10 feet high to hold the 25yr, 24 hour storm with ~2 ft of freeboard while the 5000 gallon storage tank is pumped

Once landfill is closed, 5000 gallon tank should be adequate to provide leachate storage; A water balance would be conducted during design phase to adjust tank size



Assume 100 ft of 6-inch SCH 80 HDPE leachate collection pipe to transport leachate / stormwater from landfill to storage tank

APPENDIX G

WETLAND FUNCTIONAL EVALUATION

NEW ENGLAND ENVIRONMENTAL, INC.

Environmental Consulting Services

800 Main Street
Amherst, MA 01002
(413) 256-0202
FAX (413) 256-1092

24 November 1993

Mr. John Bleiler
ABB Environmental Services, Inc.
Corporate Place 128
107 Audubon Road
Wakefield, MA 01880

RE: Response to agency comments on WET assessment, Fort Devens, MA.
NEE file #93-1011

Dear Mr. Bleiler:

As requested, New England Environmental, Inc. (NEE) has reviewed the comments relative to the WET assessment of Cold Spring Brook and Plow Shop Ponds on the Fort Devens site. Below, we have listed each comment and our response:

Comment 0-1: "The watersheds, input zones, and service areas for each assessment area need to be described and added to Figure 1. The locality and region used in the analysis also need to be defined".

NEE response: The watershed boundaries for each AA were originally included within Figure 1, although they were not labeled. Figure 1 has been revised so that the watershed boundaries within the figure have been labelled. AA1 has a small watershed, and almost the entire area is shown on Figure 1. However, the watershed for AA2 is very extensive, and covers a large portion of the USGS Ayer and Hudson Quadrangles. Therefore, the entire watershed could not be shown on Figure 1. Attached are photocopies of the USGS maps, which show the entire watershed.

As stated in the WET manual, the input zone "includes the area 300 feet upslope from the AA boundary". Since the AAs are not tributaries, the other variables of the IZ are not used. The IZs were not originally shown on Figure 1 for purposes of clarity; however, they have been added to Figure 1 and are represented by a dashed line around each AA.

The WET manual defines Service Area as "the point to which the service is delivered....The potential exists for any number of service areas to occur downstream of the AA". The watershed of AA1 is less than 20 square miles. Therefore, according to the WET manual, Service Areas within 5 miles

downstream of the AA should be considered. Since the watershed of AA2 is greater than 20 square miles, the WET manual states that service areas within 10 miles downstream should be considered. Thus, it would be unreasonable to detail all Service Areas for each AA.

The Locality and Region were defined in the Site Documentation Form A attached to the report. Locality was defined as the Town of Ayer, while Region was defined as the State of Massachusetts.

<u>Comment 0-2</u>: "The discussion on these pages [4-8] needs to be augmented since the text often does not adequately describe why a particular function or value received a particular rating. For example, on Page 8 paragraph 2, the text provides no explanation as to why the two functions listed received MODERATE ratings".

<u>NEE response</u>: This section has been augmented in order to provide information on the WET value assigned for each function. However, it must be understood that the rating assigned by WET for a particular function is based upon the responses to a wide range of questions. A complete discussion of why a particular function or value received a particular rating is beyond the scope of the report; see the Keys in the *Method for Wetland Functional Assessment* (1983) and the *Wetland Evaluation Technique Literature Review and Evaluation Rationale* (Adamus et al, 1991) for the complete list of questions and responses and their impact upon the WET results.

<u>Comment 0-3</u>: "The HIGH rating for breeding wildlife is questionable for Plow Shop Pond due to poor emergent growth and low vegetation/water interspersion, which would provide relatively poor quality brood-rearing habitat for waterfowl".

<u>NEE response</u>: The High rating referenced (page 8, paragraph 1), is under the Social Significance evaluation of Plow Shop Pond. The Social Significance, or the value of the wetland to society, of this function is determined by WET to be "High" due to the existence of "at least one wildlife species that is on USFWS National Species of Special Emphasis List (Table 1) <u>and</u> is rare or declining in the region". Table 1 lists black duck, a species which is declining in the region and which has been sighted in the AA by NEE biologists.

The poor emergent growth and low vegetation and water interspersion in Plow

Shop Pond are two factors which would reduce the Effectiveness of the area for waterfowl breeding. However, there are a number of other factors which contribute to WET's "High" rating for this function. For example, Plow Shop Pond is located near forested wetlands; these adjacent wetlands of a different type are of high importance as a predictor for breeding (WET literature review). Similarly, the edge of the wetland contains "special habitat features" as defined by WET, such as fruit bearing shrubs (highbush blueberry) and mast-bearing trees (oak); this is also of high importance to this function. Other factors contributing to the "High" rating by WET include the substrate type, low salinity, and the fact that there are preferred food plants within the AA such as *Nymphaea odorata* and *Brasenia schreberi*, which are considered by WET to be preferred food plants for waterfowl.

<u>Comment 0-4</u>: "The assumptions used in the impact evaluation need to be more completely stated. In particular, the text needs to discuss if it is assumed that groundwater will be remediated, if Grove Pond will be concurrently remediated (these two issues relate to recontamination impacts on the wetlands), and if any wetlands restoration procedures (e.g., plantings) were assumed".

<u>NEE response</u>: While groundwater remediation and the clean up of Grove Pond may take place, we have not assumed that this work will be completely effective in eliminating contaminants. Therefore, Question 27, which asks "is there a source that contributes waterborne contaminants (in concentrations hazardous to aquatic life) to the AA?" was answered "yes" for both the AA's and IA's. For most of the other questions, these assumptions, although perhaps important for a qualitative review of the effectiveness of the proposed remediation work, would have no impact on the outcome of the WET evaluation. For example, Question 26, "Nutrient Sources", asks if there is any potential nutrient source, such as a landfill, which is contributing nutrients to the AA. Even with groundwater remediation, there would still be a potential nutrient source, and the answer to this question would still be "yes". Similarly, the WET assessment would be the same with or without restoration plantings, since a three year time period was assumed for the IA assessment, which would allow for the natural re-establishment of vegetation without plantings. As stated in our report: "This time period is arbitrary, and was chosen to represent a sufficient length of time for aquatic bed vegetation to become re-established. If a shorter time period had been chosen, the WET assessment would have yielded more pronounced impacts. Conversely, since many of the impacts from the proposed work will become less

important over time, a WET assessment of the area 5 or 10 years further into the future would have yielded fewer differences between the pre and post development functions and values."

Comment 0-5: "Due to the reduction in vegetation from dredging, it is not clear why functions such as production export are not predicted to be lower than existing (baseline) conditions. Please discuss".

NEE Response: As stated under the response to Question 0-4 above, the IA evaluation was conducted at a point in time three years subsequent to the dredging work, during which time the floating-leaved vegetation would likely have become re-established. If a shorter period of time had been used in the evaluation, then our evaluation would have assumed that the vegetation would not have had sufficient time to become re-established. As a result, the value of the production export function would have been reduced by the WET program.

Comment 0-6: "Grove Pond has significant sediment contamination and would not be a suitable reference wetland for the analysis described. Please modify the text accordingly".

NEE Response: The reference to Grove Pond has been deleted from the text.

Enclosed is a copy of our WET assessment which incorporates the above revisions. Please do not hesitate calling if you have any additional questions or comments.

Sincerely yours,
New England Environmental, Inc.

Ward W. Smith
Wetland Specialist/Soil Scientist

Michael J. Marcus
Senior Biologist
Principal

WWS/if
enc.

NEW ENGLAND ENVIRONMENTAL, INC.

WETLAND EVALUATION TECHNIQUE (WET 2.0)

PLOW SHOP AND COLD SPRING BROOK PONDS FORT DEVENS, AYER, MASSACHUSETTS

Revised 24 November 1993

Prepared For:

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NEE File: 93-1011

I. WET 2.0 EVALUATIONS

Introduction to WET

Wetland Evaluation Technique (WET) assessments were conducted on the existing and post-impact conditions in Cold Spring Pond and Plow Shop Pond, which are located on and adjacent to the Fort Devens Military Installation in Ayer, Massachusetts. WET is a standardized evaluation technique for wetlands which yields a rapid assessment of many of the recognized values and functions of a wetland. Functions and values were evaluated in a Level 2 WET assessment, which is generally considered to be a reasonable balance between time, available information, and level of confidence for most situations. WET uses a standardized manual and answer sheet to provide input data for the WET computer program (See Appendix 1). After data are entered into the WET program, a "Low", "Medium", or "High" value is assigned to each function based upon this input.

A combination of eleven functions (i.e., physical, chemical, and biological characteristics) and values (characteristics beneficial to society) are evaluated by the WET program. Each of these functions and values is defined below. These definitions are found in *Wetland Evaluation Technique Literature Review and Evaluation Rationale* (Adamus et al, 1991).

* **Ground Water Recharge** "is the movement of surface water or precipitation into the ground water flow system".

* **Ground Water Discharge** "is the movement (usually laterally or upward) of ground water into surface water".

* **Floodflow Alteration** "is the process by which peak flows from run-off, surface flow, ground water interflow and discharge, and precipitation enter a wetland and are stored or delayed in their downslope journey".

* **Sediment Stabilization** "consists of both shoreline anchoring and dissipation of erosive forces".

* **Sediment/Toxicant Retention** "is the process by which suspended solids and chemical contaminants such as pesticides and heavy metals adsorbed to them are retained and deposited within a wetland".

* **Nutrient Removal/Transformation** "includes the storage of nutrients within the sediment or plant substrate; the transformation of inorganic nutrients to their

organic forms; and the transformation and subsequent removal of one nutrient (nitrogen) as a gas".

* **Production Export** "refers to the flushing of relatively large amounts of organic material (specifically, carbon from net annual primary and secondary productivity) from the wetland to downstream or adjacent deeper waters".

* **Wildlife Diversity/Abundance** "is the support of a notably great on-site diversity and/or abundance of wetland-dependant birds".

* **Aquatic Diversity/Abundance** "is the support of a notably great on-site diversity and/or abundance of fish or invertebrates that are mainly confined to the water and saturated soils".

* **Uniqueness/Heritage** "includes the use of wetlands for aesthetic enjoyment, nature study, education, scientific research, open space, preservation of rare or endemic species, protection of archaeologically or geologically unique features, maintenance of historic sites, and an infinite number of other mostly intangible uses".

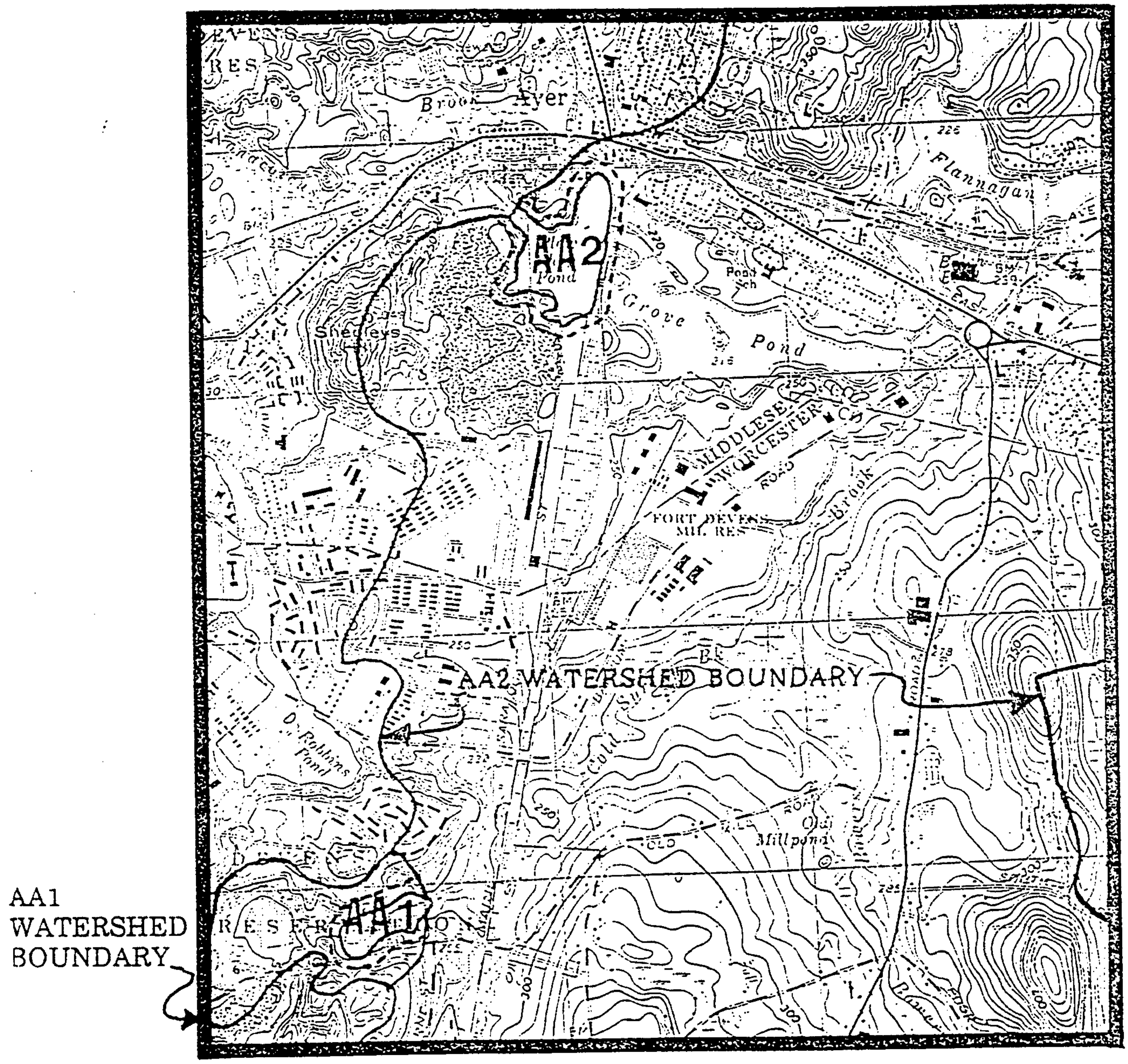
* **Recreation** "includes both consumptive (e.g., sport fishing, food gathering, hunting) and nonconsumptive (e.g., swimming, canoeing, kayaking, birding) forms of recreation that are water dependant and occur in either an incidental or obligatory manner in wetlands".

The above listed functions and values were evaluated by WET in the following contexts: **Social Significance** (the value of the wetland to society); **Effectiveness** (the capability of the wetland to provide the function); and **Opportunity** (the opportunity of the wetland to provide the function).

Using the criteria described in the WET manual, the Assessment Area (AA) for each pond was determined to include not only the ponds, but the surrounding fringe of woody wetland vegetation as well. A WET assessment was conducted based upon the entire AA. A WET evaluation of the probable impacts resulting from removing one foot of sediment from the bottom of each pond was conducted at a point in time three years subsequent to the completion of the work. No detailed plans have yet been formulated for the precise extent of the remediation work. In order to provide a meaningful comparison between the wetlands before and after this work, the boundaries of each Impact Area (IA) were assumed to be

FIGURE 1

NEW ENGLAND ENVIRONMENTAL, INC.



USGS AYER QUADRANGLE
SCALE: 1:25,000

identical to the AA boundary for each pond, although not all of the AA may be altered by the remediation work.

Data for the WET analysis were collected from a number of sources, including the following: site visits by NEE personnel; site reports and documentation provided by ABB, Inc.; previous ecological investigations data by Ecology & Environment, Inc. (June, 1992); the Soil Survey of Middlesex County; FEMA floodplain maps; the USGS Ayer quadrangle; and telephone conversations with the Soil Conservation Service, Natural Heritage and Endangered Species Program, and the National Climactic Data Center. Our evaluation of the WET results is based in part upon the *Wetland Evaluation Technique Literature Review and Evaluation Rationale* (Adamus et al, 1991) and the *Method for Wetland Functional Assessment* (1983).

Cold Spring Brook Pond (AA1)

The first Assessment Area (AA1), Cold Spring Brook Pond, is located to the west of Marne Street (see Figure 1). The boundaries of this AA include the fringe of shrub swamp and wooded swamp which lies to the north of the pond. The western boundary of AA1 is the inlet stream from the upgradient wetland, while the eastern boundary is the culverted outlet beneath Patton Road. The southern limit of this AA is primarily a landfill slope.

Social Significance of AA1

Social Significance is the value of a wetland to society. As shown in Table 1, WET rates the value of Cold Spring Brook Pond to society as "High" for Wildlife Diversity and Abundance as well as Uniqueness and Heritage. The Social Significance of Plow Shop Pond for Wildlife Diversity and Abundance is rated by WET as "High" based upon the existence of black duck, a species that is on the USFWS National Species of Special Emphasis List and is declining in the region. The Social Significance of the Uniqueness and Heritage value is rated as "High" due, in part, to the presence of a long-term monitoring program on the adjacent landfill.

Table 1: Summary of Wet Results for Cold Spring Brook Pond

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge	M	L	*
Ground Water Discharge	M	M	*
Floodflow Alteration	L	M	M
Sediment Stabilization	L	H	*
Sediment/Toxicant Retention	L	H	H
Nutrient Removal/Transformation	L	H	H
Production Export	*	M	*
Wildlife Diversity/Abundance	H	*	*
Wildlife D/A Breeding	*	H	*
Wildlife D/A Migration	*	H	*
Wildlife D/A Wintering	*	L	*
Aquatic Diversity/Abundance	L	L	*
Uniqueness/Heritage	H	*	*
Recreation	L	*	*

Note: "H" = High, "M" = Moderate, "L" = Low, "U" = Uncertain, and "*"'s identify conditions where functions and values are not evaluated

The Social Significance of the ground water functions are rated by WET as "Moderate" for this wetland, which is largely due to the downgradient wellfields. The remainder of the evaluated functions are "Low" in Social Significance. The low value of many of these functions is due in part to the small size and watershed of this AA. In addition, the Social Significance of the Floodflow Alteration function is low due to the lack of features of social or economic value within the floodplain to the AA. The Social Significance of the Sediment/Toxicant retention and Nutrient Removal/Transformation functions are low due in part to a lack of surface water drinking supplies or swimming areas downstream. The Social Significance of the Aquatic Diversity/Abundance is Low due to the lack of commercial fishing, recognized fisheries value of the AA, or the lack of any fish species which are on the USFWS National Species of Special Emphasis List. The Social Significance of the Recreation function is Low due to the fact that the AA is not a major public access point to a recreational waterway, nor is it recognized as an area which provides recreational opportunities that are locally deficient. The Social Significance of the Sediment Stabilization function is low because the AA does not act as a buffer to features situated in erosion prone areas.

Effectiveness of AA1

Effectiveness is the capability of a wetland to perform a given function. Using this parameter, WET rates Cold Spring Brook Pond as "High" for Sediment/Toxicant Retention, Nutrient Removal/Transformation, and Wildlife Breeding and Migration. The Effectiveness of the wetland in performing the Sediment/Toxicant Retention and Nutrient Removal/Transformation functions is enhanced by a number of factors including the low water velocity, constricted outlet, and the shallow water depth within this area. The Effectiveness of the wetland to provide the wildlife functions is based upon a number of factors, including the interspersion of openwater and vegetation in the wetland, the diversity of the different vegetation types, the shape of the upland/wetland edge, and the sapric substrates within the wetland. Since this function is relative to waterfowl, the fact that Cold Spring Brook Pond has several aquatic bed species which are important food sources for waterfowl increases the Effectiveness of this wetland for Wildlife Diversity/Abundance Migration.

The Effectiveness of this Assessment Area is rated as "Moderate" for Ground Water Discharge, Floodflow Alteration, and Production Export. The wetland is determined to be moderately effective for Ground Water Discharge due to a number of factors, including the landscape position of the AA. Floodflow Alteration Effectiveness is enhanced by the constricted outlet to the wetland. The Effectiveness of Production Export is a function of factors such as the vegetation classes found in the AA and the relatively large portion of its watershed the wetland occupies.

The Effectiveness of this wetland to provide several functions/values is rated as "Low" by WET. For example, the area will have a low value for wintering waterfowl (Wildlife Diversity/Abundance Wintering) due to the fact that it is a shallow wetland and becomes completely frozen during the winter months. Groundwater Recharge is Low due the wet key functions; since a level 3 assessment was not run, question 60 was not answered "N", and the program assigned a "low" value. If question 60 had been answered "N", the WET program would have yielded an "Uncertain" rating. However, the majority of wetlands in New England are not recharge wetlands. Aquatic Diversity/Abundance is low due to the presence of the adjacent landfill combined with the lack of a perennial outlet, which would tend to trap contaminants within the AA.

Opportunity of AA1

Most of the functions and values are not evaluated for Opportunity in a Level 2 WET Assessment. Of the three functions/values evaluated, the opportunity for Cold Spring Pond to perform the Sediment/Toxicant Retention and Nutrient Removal/Transformation functions is rated as "High" by WET. Cold Spring Pond has the opportunity to provide these functions due to the proximity of the adjacent landfill. Floodflow Alteration is rated as "Moderate" by WET based upon the high percentage of the watershed this wetland occupies. While the watershed is small, which reduces the opportunity for this function, there are relatively few wetlands upgradient of this area, which increases the opportunity for this function.

Plow Shop Pond (AA2)

Plow Shop Pond (AA2) is located downgradient of AA1, and is situated close to the center of Ayer (see Figure 1). The upper limit of this Assessment Area is the culverted inlet from Grove Pond, while the lower limit is the dammed outlet. The AA includes the narrow fringe of scrub-shrub and forested wetland which surrounds the Pond.

Table 2: Summary of Wet Results for Plow Shop Pond

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge	H	U	*
Ground Water Discharge	H	L	*
Floodflow Alteration	L	M	M
Sediment Stabilization	L	M	*
Sediment/Toxicant Retention	M	H	H
Nutrient Removal/Transformation	M	L	H
Production Export	*	M	*
Wildlife Diversity/Abundance	H	*	*
Wildlife D/A Breeding	*	H	*
Wildlife D/A Migration	*	L	*
Wildlife D/A Wintering	*	L	*
Aquatic Diversity/Abundance	L	L	*
Uniqueness/Heritage	H	*	*
Recreation	L	*	*

Note: "H" = High, "M" = Moderate, "L" = Low, "U" = Uncertain, and "*"'s identify conditions where functions and values are not evaluated

Social Significance of AA2

Functions which WET determines to be "High" for the Social Significance of Plow Shop Pond are Ground Water Recharge, Ground Water Discharge, Wildlife Diversity and Abundance, and Uniqueness and Heritage. The significance of Plow Shop Pond for the groundwater functions is due to its proximity to water supply wellfields and the permeable sediments within the area. Like Cold Spring Brook Pond, The Social Significance of Plow Shop Pond for Wildlife Diversity and Abundance is rated by WET as "High" based upon the existence of black duck, a species that is on the USFWS National Species of Special Emphasis List and is declining in the region. The Social Significance of the Uniqueness and Heritage value is rated as "High" due, in part, to the presence of a long-term monitoring program on the adjacent landfill.

The Social Significance of the Sediment/Toxicant Retention and Nutrient Removal/Transformation functions in this wetland are rated as "Moderate" by WET. Both of these ratings are due to the elevated levels of nutrients and other pollutants resulting from the adjacent landfill.

WET rates the Social Significance and Effectiveness of Plow Shop Pond as "Low" for several functions. The Social Significance of the Aquatic Diversity/Abundance is Low due to the lack of commercial fishing, recognized fisheries value of the AA, or the lack of any fish species which are on the USFWS National Species of Special Emphasis List. The Social Significance of the Recreation function is Low due to the fact that the AA is not a major public access point to a recreational waterway, nor is it recognized as an area which provides recreational opportunities that are locally deficient. The Social Significance of the Floodflow Alteration function is low due to the lack of features of social or economic value within the floodplain to the AA. The Social Significance of the Sediment Stabilization function is low because the AA does not act as a buffer to features situated in erosion prone areas.

Effectiveness of AA2

The Effectiveness, or the capability of AA2 to preform a given function, is rated as "High" for Sediment/Toxicant retention and Wildlife Diversity/Abundance Breeding. As with AA1, the Effectiveness of this wetland for Sediment/Toxicant retention is a function of the physical parameters of the Pond including the constricted outlet, low water velocity, and shallow depth. The breeding function

for wildlife, while reduced somewhat by the poor emergent growth and low vegetation and water interspersion in Plow Shop Pond, is raised by a number of other factors which contribute to WET's "High" rating for this function. For example, Plow Shop Pond is located near forested wetlands; these adjacent wetlands of a different type are of high importance as a predictor for breeding (WET literature review). Similarly, the edge of the wetland contains "special habitat features" as defined by WET, such as fruit bearing shrubs (highbush blueberry) and mast-bearing trees (oak); this also is of high importance to this function. Other factors contributing to the "High" rating by WET include the substrate type, low salinity, and the fact that there are preferred food plants within the AA such as *Nymphaea odorata* and *Brasenia schreberi*, which are considered by WET to be preferred food plants for waterfowl.

WET rates the effectiveness of AA2 for Floodflow Alteration, Sediment Stabilization, and Production Export as "Moderate". The moderate rating for Floodflow alteration is based upon such features as the restricted outlet, which allows it to provide for flood storage. However, the AA does not have any of the features which would yield a "High" rating for this function, such as a regulated outlet.

Sediment Stabilization is also rated as "Moderate" due to the lack of features resulting in either a High or Low rating. According to the WET Manual: "Wetlands rated HIGH for this function must be characterized by one of the following characteristics: potential erosive forces present, unsheltered or Zone C greater than Zones A and B, ditches, canals, or levees are present that confine water, high water velocity, evidence of long-term erosion, or a water table influenced by an upstream impoundment. In addition, one of the following characteristics must also be present: rubble substrate, protective of nearby shorelines, greater than 20 ft width of erect vegetation, presence of forest of scrub-shrub, or good water and vegetation interspersion. The only type of wetland considered capable of being rated LOW is one in which there is no flowing water, no boat wakes, no open water wider than 100 ft, and no eroding areas abutting the wetland, as well as having no vegetation (erect or submerged) or rubble."

Like Sediment Stabilization, the "Moderate" rating for Production Export is due to the lack of factors which would result in either a High or Low rating. "To attain a rating of HIGH, the assessment area must have conditions favoring primary productivity...If the wetland system is palustrine the following conditions must be present: significant areas of erect vegetation, potential erosive conditions, Zone B

greater than 10% of AA, potential for expansive flooding, potential for eutrophic conditions or high levels of dissolved solids, high plant productivity, and fringe or island situation. In addition, for all wetland systems, one of the following conditions must not be present: moss-lichen class extensive, sandy substrate, water velocity high or AA unsheltered, low water\vegetation interspersion, presence of direct alteration, artificially manipulated water levels, small watershed, or low levels of suspended solids. To attain a rating of LOW, the AA must have no permanent or intermittent outlets regardless of the levels of productivity present." Since Plow Shop Pond has low interspersion, a "High" rating could not be assigned by WET. Likewise, the permanent inlet and outlet precludes the "Low" rating.

The remainder of the functions and values evaluated by WET are rated as "Low" for Effectiveness. It is interesting to note that WET determines that the Effectiveness of this wetland for the Aquatic Diversity/Abundance function is "Low". As defined previously, this function is "the support of a notably great on-site diversity and/or abundance of fish or invertebrates that are mainly confined to the water and saturated soil". However, although the WET program predicts that this function is "Low" for Plow Shop Pond, our qualitative evaluation is that the Pond is very valuable for this function based upon the abundance of breeding fish. Based upon our on-site visit, we believe that this wetland is very effective at supporting an abundance of warm-water fish species. Ground Water Discharge is rated as low because the wetland has only one of the characteristics that would qualify it as "High" for this function, a relatively stable water level. Nutrient Removal/Transformation rates Low due to the lack of extensive erect vegetation within the wetland. Wildlife Diversity/Abundance Migration and Wintering are rated as "Low" based, in part, upon the fact that Plow Shop Pond is frozen for more than one month during the winter.

Opportunity of AA2

The results for Opportunity for Plow Shop Pond are identical to those for Cold Spring Pond (AA1). As with AA1, most of the functions and values were not evaluated by WET for Opportunity in this Level 2 WET Assessment. The opportunity for Plow Shop Pond to perform the Sediment/Toxicant Retention and Nutrient Removal/Transformation functions is rated as "High" by WET due to the proximity of the adjacent landfill. The opportunity for AA2 to provide for Floodflow Alteration was rated as "Moderate" by WET. This is likely due in part to the relatively large watershed relative to the size of the AA.

Impact Area Evaluations

Both Assessment Areas were evaluated based upon the probable impacts resulting from the removal of one foot of sediment from the bottom of each pond. Each Impact Area was evaluated at a point in time three years subsequent to the completion of this work. This time period is arbitrary, and was chosen by NEE to represent a sufficient length of time for aquatic bed vegetation to become re-established. If a shorter time period had been chosen, the WET assessment would have yielded more pronounced impacts. Conversely, since many of the impacts from the proposed work will become less important with time, a WET assessment of the area 5 or 10 years further into the future would have yielded fewer differences between the pre- and post- development functions and values. Although it can be assumed that groundwater remediation will take place, we did not assume that this work will be completely effective in eliminating contaminants from these wetlands.

WET predicts that the Effectiveness of both IAs will be reduced for the Sediment/Toxicant Retention and Wildlife Diversity/Abundance-Breeding functions, while the Nutrient Removal/Transformation function will be reduced within Cold Spring Brook Pond. The reduction in the Effectiveness of the Sediment/Toxicant Removal function and the Nutrient Removal/Transformation function is due to the alteration of the wetlands. Alterations which destroy vegetation that slows water movement reduces the ability of the wetland to retain sediments. Wetlands which have been excavated are less likely to remove and/or transform nutrients in the water column. In addition, the removal of one foot of sediment will increase the depth of these waterbodies, and deeper wetlands may be less likely to retain sediments and toxicants than shallower wetlands. Finally, the conversion of the substrates within portions of Plow Shop Pond from muck to sand and gravel will reduce the ability of the wetland to trap sediments.

Wildlife Diversity/Abundance-Breeding was determined to be reduced subsequent to the alteration of the area. This is due to the disruption of wetland functions that are important to wildlife following alterations. However, if we had modeled this for longer than 3 years following the alteration, then this would not have had an impact on WET.

Other functions, such as Production Export, were unchanged over the baseline values for the AAs. Production Export is likely unchanged because of the time period used. As previously discussed, the three year time period is likely

Table 3: Summary of Wet Results for Cold Spring Pond, Post-Impact

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge	M	L	*
Ground Water Discharge	M	M	*
Floodflow Alteration	L	M	M
Sediment Stabilization	L	H	*
Sediment/Toxicant Retention	L	L	H
Nutrient Removal/Transformation	L	L	H
Production Export	*	M	*
Wildlife Diversity/Abundance	H	*	*
Wildlife D/A Breeding	*	L	*
Wildlife D/A Migration	*	H	*
Wildlife D/A Wintering	*	L	*
Aquatic Diversity/Abundance	L	L	*
Uniqueness/Heritage	H	*	*
Recreation	L	*	*

Note: "H" = High, "M" = Moderate, "L" = Low, "U" = Uncertain, and "*"'s identify conditions where functions and values are not evaluated

Table 4: Summary of Wet Results for Plow Shop Pond, Post-Impact

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge	H	U	*
Ground Water Discharge	H	L	*
Floodflow Alteration	L	M	M
Sediment Stabilization	L	M	*
Sediment/Toxicant Retention	M	L	H
Nutrient Removal/Transformation	M	L	H
Production Export	*	M	*
Wildlife Diversity/Abundance	H	*	*
Wildlife D/A Breeding	*	L	*
Wildlife D/A Migration	*	L	*
Wildlife D/A Wintering	*	L	*
Aquatic Diversity/Abundance	L	L	*
Uniqueness/Heritage	H	*	*
Recreation	L	*	*

Note: "H" = High, "M" = Moderate, "L" = Low, "U" = Uncertain, and "*"'s identify conditions where functions and values are not evaluated

sufficient to allow floating-leaved vegetation to become re-established. If a shorter period of time had been used in the evaluation, then this function would have shown a decrease over baseline conditions.

WET Summary

A standardized evaluation technique, WET (Wetland Evaluation Technique), was used to conduct assessments on the existing and post-impact conditions in Cold Spring Brook Pond and Plow Shop Pond on the Fort Devens site. The WET analysis determined that the value of both of these wetlands to society is "High" for Wildlife Diversity and Abundance as well as Uniqueness and Heritage. The value of Plow Shop Pond to society is also "High" for Ground Water Recharge and Ground Water Discharge.

WET predicts that the proposed removal of one foot of sediment from the bottom of these ponds will reduce the effectiveness of both wetlands to preform the Sediment/Toxicant Retention and Wildlife Diversity/Abundance-Breeding functions. The Nutrient Removal/Transformation function will be reduced within Cold Spring Brook Pond by the work as predicted by WET.

II. OTHER WETLAND FUNCTIONAL ASSESSMENT METHODS

Hollands and McGee

A Hollands & McGee (H&M) Wetland Functional Assessment (1985) was conducted on Plow Shop Pond and Cold Spring Pond by Ecology and Environment, Inc. as part of their assessment of these wetlands. The Hollands and McGee method was developed by private consulting firms (IEP and Normandeau), and the details of conducting or evaluating this method are generally not available to the public, nor has the complete method been published. The ecological elements in H&M are based largely on the work of Golet & Larson (1974). However, since this method was developed and tested in Massachusetts in 1975, it has the potential for broad applications in the functional assessments of wetlands in this region. The H&M method evaluates 10 wetland functions which incorporate biological, hydrological and socio-cultural interests.

The primary uses of the Hollands and Mcgee method are to compare different wetlands in a region (i.e. a town, county, etc.) so that the relative importance of functional values can be made. This method has been successfully used to evaluate and compare hundreds of wetlands in municipalities in Massachusetts, New Hampshire, and Wisconsin. Although Hollands and McGee (1985) believe that their method compares favorably with more complex methods such as Adamus (1983), which was the precursor to WET 2.0, the two methods have a very different approach. The H&M method relies on expert field personnel which include, at a minimum, a geologist, hydrologist, botanist, and an ecologist to collect site specific detailed data on the wetland(s) being investigated. WET, on the other hand, is designed to be conducted primarily from the office, with minimal field work and non-technical staff. In this respect, the H&M method is similar to the newer Hydrogeomorphic approach which is discussed below.

The H&M wetland evaluation conducted for Cold Spring Brook Pond and Plow Shop Pond provides no regional basis from which to make a decision on the level of the functions found in these wetlands. For instance, the biological model for Plow Shop Pond received a H&M score of 110, while Cold Spring Pond rated 102 for this function. Both were identified as "Moderate" due to a range of scores of this model between 29-158, with a mean of 93. However, practical use of this model indicates that a score of 110 is generally considered "Low" on a regional basis for this part of Massachusetts. Although the H&M system rates these wetlands as "Moderate" in reference to other functional models which require the

output of the biological model, without a comparison of other reference wetlands in the regions, the rating of individual wetland functional values is not appropriate using the H&M method.

Hydrogeomorphic Properties

A recent development in the functional assessment of wetlands is to classify wetlands based on hydrogeomorphic (HGM) properties as is discussed by Brinson et. al (1993, in press). This method is based on a scientific team approach, as in the H&M method, and uses the four following guidelines, or logic train to qualify a function for this method: 1) the function must be clearly defined; 2) it must have recognizable sustaining forces; 3) the function must have hydrologic, geomorphic, or ecologic significance either on the site or off the site; and 4) it must have indicators that can be documented and combined into a functional index that is scaled to reference wetlands.

The HGM method classifies wetlands based on their major properties, such as the geomorphic setting, the sources of water supplying the wetland, and the hydrodynamics of water within the wetland. By first grouping the different wetlands into the HGM classes with similar properties, the functional assessment is defined to address the functions which are linked. This step represents the scientific basis for the presence of the function. The next step is to develop functional profiles for each wetland class. Finally, a scale for expressing functions by using reference wetlands is developed. These reference wetlands are developed for each wetland class in order to serve as the benchmarks for the HGM classes. The reference wetlands are also critical to the setting of goals for compensatory mitigation, and become a standard from which success or failure may be measured. For example, in the H&M wetland functional assessment of both Plow Shop Pond and Cold Spring Brook Pond, no reference was made to the surrounding wetlands, even though there are similar ponds with aquatic beds located in close proximity. A modeled value is of little use if it cannot be compared with either a standard, or a point of reference.

As discussed by the Conservation Foundation (1988), Brinson et al. and Larson and Mazzarese (in press), the general approach which is used to assess the functions of wetlands is to use a generic list of possible wetland functions, and then look for evidence that the wetland being assessed actually performs the functions. As an example, if a given wetland has permanent standing water, is connected to a larger body of water, and has interspersion of both emergent and

submerged vegetation, as in Cold Spring Brook Pond, then it will likely support fish populations, and will thus be determined to have a high probability of aquatic food web support. This general approach has several problems in that a generic series of questions fails to explicitly define the relationship between properties of the wetland and the functions it is supposed to be performing. This "Black Box" approach (Brinson, et al) makes it difficult for the user to understand, learn from, or question the assumed relationships between wetland properties and functions. In fact, these procedures are applied without ever acknowledging the wetland class and its associated attributes.

The HGM approach emphasizes the use of reference wetland populations for the documentation of the relationship between disturbance and function. As such, they are viewed as natural laboratories and as targets for creation and restoration activities. For example, under this approach there is no need to develop complex and detailed design criteria that specify the number of trees to plant, the species composition of the plant community, or the slope and hydroperiod of the wetland surface. Rather, the species composition, cover, density, and other properties of the reference wetlands of a given class can serve as the goals for mitigation. Of importance to any future wetlands mitigation at Fort Devens is that the Discrete use of reference wetland populations in the region of the Base eliminates the need to consider "opportunity" and "effectiveness" as necessary conditions for high rankings of some functions.

Summary

Based on our experience using WET 2.0, Hollands and McGee, and other wetland functional assessment methods, it is our opinion that, if restoration of these wetlands is necessary, then the functional assessments of Plow Shop Pond and Cold Spring Brook Pond should also be compared with other regional wetlands which contain similar characteristics. While WET provides a generic functional assessment of the wetlands, a comparison with other reference wetlands of similar classes would provide a necessary ingredient for future mitigation work. Any future remediation success of Plow Shop Pond must be measured against not only the existing conditions of the Pond, but against other non-impacted Ponds in the region.

III. QUALITATIVE WETLAND EVALUATIONS

A. COLD SPRING BROOK POND

Introduction

The area surrounding Cold Spring Brook Pond was examined on June 16, 1993. This pond was formed by the construction of Patton Road and the subsequent blockage of the culverted outlet to the wetland. The pond is essentially a dammed part of Cold Spring Brook, with the dam created by a road culvert that passes under Patton Road. Possible dredge spoils and piled peat material are located around parts of the pond perimeter, and this indicates that the pond may have been dredged in the past. The pond is adjacent to the Cold Spring Brook Landfill site (on the west and south) and a magazine storage area (to the west). Cold Spring Brook Pond was generally evaluated as part of a WET evaluation and as part of a qualitative evaluation for plant communities, wetland types, and ecological structure. The purpose of this section is to present a qualitative wetland evaluation of the existing wetland system.

Plant Communities

Four major plant communities were observed within Cold Spring Pond and its fringe wetland: an Aquatic Bed Plant Community; an Emergent Plant Community; a Shrub/Scrub type; and Forested Swamp. Each of these is described separately below.

Aquatic Bed Plant Community

The majority of the Cold Spring Pond wetland system is occupied by an open water aquatic bed plant community. Although the exact bathometric depths are unknown, much of the pond is relatively shallow, and is able to support rooted aquatic plant life that responds to a two meter phototrophic zone. Sweet water lily (*Nymphaea odorata*), water shield (*Brasenia schreberi*), water marigold (*Megalodonta beckii*), duckweed (*Spirodela* spp.), and coontail (*Ceratophyllum demersum*) were noted in this plant community.

Emergent Plant Community

Much of the shoreline border contains emergent marsh plants, although this band of vegetation is relatively narrow. These plants are generally obligate to facultative wetland plants as rated by the *National List of Plant Species that Occur in Wetlands* (Reed, 1988); these species can easily survive extended periods of saturated soils and flooded conditions. The following plants were observed around the shoreline in the emergent marsh community: tussock sedge (*Carex stricta*), bearded sedge (*Carex comosa*), purple iris (*Iris versicolor*), cattail (*Typha latifolia*), water willow (*Justicia americana*), purple loosestrife (*Lythrum salicaria*), and bugleweed (*Lycopus virginica*).

Shrub/Scrub Plant Community

At the western end of the pond and along parts of the pond perimeter there exists a shrub/scrub wetland plant community. The plant community on the western end is dominated by button bush (*Cephalanthus occidentalis*), smooth alder (*Alnus serrulata*), and silky dogwood (*Cornus amomum*). The understory in this area contains enchanter's nightshade (*Circaea alpina*), sedges (*Carex* spp.), and spotted jewelweed (*Impatiens capensis*). Other perimeter shrub/scrub wetlands are scattered along the perimeter of the pond and contain swamp azalea (*Rhododendron viscosum*), highbush blueberry (*Vaccinium corymbosum*), fetterbush (*Leucothoe racemosa*), winterberry holly (*Ilex verticilatta*), sheep laurel (*Kalmia angustifolia*), maleberry (*Lyonia lingustrina*), and red chokeberry (*Aronia arbutifolia*).

Forested Swamp

There are a few small areas of wetland that are red maple swamps. These areas are located along the fringe of the wetland system and on the peninsula which extends into the pond on its northwestern side. Although red maple (*Acer rubrum*) dominates these areas, gray birch (*Betula populifolia*), silky dogwood (*Cornus amomum*), smooth alder (*Alnus serrulata*), and swamp dewberry (*Rubus hispidus*) are common.

On the southeastern side of this wetland system there is a swamp which is dominated by white pines (*Pinus strobus*) in addition to red maple (*Acer rubrum*). The understory in this area contains american hazelnut, cinnamon fern, and clubmoss.

Wildlife Habitat

Although this report is not intended to provide a detailed habitat evaluation, we will briefly discuss the importance of the evaluated area to wildlife. The open water in Cold Spring Pond provides valuable wildlife habitat for many waterfowl species including black ducks, mallards, wood ducks, great blue heron, green heron, and canada goose. While few of these birds nest here, it is very valuable for forage habitat, providing ample hunting and foraging opportunities. Evidence of breeding black duck was observed within this wetland, and the presence of a wood duck nesting box indicates that this species may be breeding here, or has nested here in the past. The wetland is used by a great variety of reptiles and amphibians including: painted turtle; snapping turtle; bullfrog; pickerel frog, green frog, northern water snake, and others. Mammals likely using the area include muskrat, beaver, raccoon, opossum, and northern water shrew. Although there is no recent beaver activity, signs of past beaver activity exist, particularly in the location of the forested landfill area.

The plant community in the wetland and surrounding upland provides good forage, cover, and escape habitat for wildlife. There are many fruit bearing shrubs and trees, as well as good diversity between strata providing ample nesting, foraging, and breeding habitat for a variety of birds and mammals. The area also has a strong ecotone where forest meets open water. As a general assessment, it is our opinion that this pond, as it presently exists, provides a diverse and valuable wildlife habitat.

The open water area provides potential habitat for a variety of benthic macroinvertebrates and fish. Water quality is the driving force that dictates which species can inhabit this particular environment. The most likely fish that may be found in this pond are golden shiners, yellow bullhead, pumpkinseed, and bluegill. Some evidence of fishing in this pond (bobbers, worm containers, fish-hook packages, etc.) was observed, particularly near the outlet end of the pond.

Observed Impacts

Based upon our field observations, the biology of Cold Spring Brook Pond appears to be at relatively normal levels. However, there is a small pond upgradient of Cold Spring Brook Pond which is heavily discolored with a rust colored substance. The aquatic plant life in this pond is reduced in diversity, abundance, and apparent overall health as compared with the downstream Cold Spring Brook

Pond. The channel draining this small pond contains similar coloration as well as a lack of plant and animal diversity and abundance. The small amount of discoloration in Cold Spring Brook pond is primarily near the inlet from this upgradient channel. No other noticeable plumes or areas of apparently impacted plant and animal life were observed.

Wetland Permits

The wetland Resource Areas around Cold Spring Pond have been previously delineated and surveyed by another consultant. Based on our review of the flagged wetland boundaries, it is our opinion that these flagged boundaries do not accurately depict the wetlands which are jurisdictional under the Massachusetts Wetlands Protection Act (M.G.L. chapter 131, section 40) and Regulations (310 CMR 10.00) or under Section 401 and Section 404 of the Clean Water Act. In general, we found that the flagged wetland boundary underestimated the area of wetlands based both upon vegetative criteria, as specified in the Regulations (310 CMR 10.00) to the Act, as well as the three parameter approach as outlined in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (1987).

Only the Ayer Conservation Commission, or the Massachusetts Department of Environmental Protection on appeal, can make the final determination of the extent of the wetland resource areas which are regulated under state law. Similarly, the extent of wetlands which are subject to federal jurisdiction under Section 404 of the Clean Water Act can be determined only by the U.S. Army Corps of Engineers.

Massachusetts Wetland Protection Act

All wetlands on this site are subject to protection under the Massachusetts Wetlands Protection Act. Under the Regulations to the Act, protectable wetlands are broken down into "Resource Areas". The wetland Resource Areas on site include:

* Land Under Waterway or Waterbody (Cold Spring Brook Pond and the streams)
* Bank (the Banks of the Pond and streams)
* Bordering Vegetated Wetland

No portions of this property are within the 100 year floodplain according to the Flood Insurance Rate Map (Ayer, MA. Panel 3 of 4, 1982). The site does not fall

within the estimated range of state-listed rare wetlands wildlife according to the 1993 Natural Heritage and Endangered Species Program Atlas.

Any work which occurs within 100 feet of the wetland Resource Areas on the site is subject to the jurisdiction of the Ayer Conservation Commission, and will require the filing of either a Request for Determination of Applicability or a Notice of Intent. It is possible that any large-scale remediation project would be approved as a Limited Project under section 10.53(4) in the wetlands regulations.

Federal Wetland Jurisdiction under Section 401 of the Clean Water Act

All projects which propose to alter wetlands require Water Quality Certification under Section 401 of the Federal Clean Water Act before work can proceed. Since October 1, 1992 the D.E.P. regions have been administering the 401 Program and now use the state criteria to determine the boundary of wetlands protectable under 401. If the proposed work will alter in excess of 5,000 square feet of wetlands, then the project will be subject to an alternatives analysis and a more lengthy review process by the D.E.P., and may possibly be denied Certification.

Federal Wetland Jurisdiction under Section 404 of the Clean Water Act

All wetlands on the property are subject to protection under Section 404 of the Clean Water Act. The boundary of wetlands which are protectable under Section 404 is different than that delineated under the Wetlands Protection Act and Section 401 of the Clean Water Act. On this site, it appears that the flagged wetland boundary does not reflect the extent of the wetlands which would be delineated based upon the methodology described in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (1987). This manual describes a multiple parameter methodology which uses the presence of hydric soils, hydrophytic vegetation, and wetland hydrology to establish the boundary of the wetlands. This manual has superseded the more recent *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989) for federal wetland boundary delineations.

TABLE 5: PLANT SPECIES FOUND IN WETLANDS, COLD SPRING BROOK POND, FORT DEVENS, AYER, MASSACHUSETTS

COMMON NAME	SCIENTIFIC NAME	INDICATOR STATUS*
Trees		
Red Maple	*Acer rubrum*	FAC
Gray Birch	*Betula populifolia*	FAC
Green Ash	*Fraxinus pennsylvanica*	FACW
Red Pine	*Pinus resinosa*	FACU
White Pine	*Pinus strobus*	FACU
Quaking Aspen	*Populus tremula*	FACU
Black Cherry	*Prunus serotina*	FACU
White Oak	*Quercus alba*	FACU-
Red Oak	*Quercus rubra*	FACU-
American Elm	*Ulmus americana*	FACW-
Shrubs		
Speckled Alder	*Alnus rugosa*	FACW+
Smooth Alder	*Alnus serrulata*	OBL
Red Chokeberry	*Aronia arbutifolia*	FACW
Common Buttonbush	*Cephalanthus occidentalis*	OBL
Silky Dogwood	*Cornus amomum*	FACW
American Hazelnut	*Corylus americana*	FACU-
Witch Hazel	*Hamamelis virginiana*	FAC-
Winterberry Holly	*Ilex verticillata*	FACW+
Sheep Laurel	*Kalmia angustifolia*	FAC
Fetterbush	*Leucothoe racemosa*	FACW
Maleberry	*Lyonia ligustrina*	FACW
Mountain Holly	*Nemopanthus mucronatus*	OBL
Swamp Azalea	*Rhododendron viscosum*	OBL
Willows	*Salix* spp.	FACW
Meadowsweet	*Spirea latifolia*	FAC+
Steeplebush	*Spirea tomentosa*	FACW
Highbush Blueberry	*Vaccinium corymbosum*	FACW-

Lowbush Blueberry	*Vaccinium angustifolium*	FACU-
Wild Raisin	*Viburnum cassinoides*	FACW
Northern Arrowwood	*Viburnum recognitum*	FACW-

Ilianas

Poison Ivy	*Toxicodendron radicans*	FAC
Grape	*Vitis* spp.	FACW-FACU

Ferns

Spinulose Woodfern	*Dryopteris spinulosa*	FAC+
Field Horsetail	*Equisetum arvense*	FAC
Princess Pine Clubmoss	*Lycopodium obscurum*	FACU
Sensitive Fern	*Onoclea sensibilis*	FACW
Cinnamon Fern	*Osmunda cinnamomea*	FACW
Interrupted Fern	*Osmunda claytoniana*	FAC
Royal Fern	*Osmunda regalis*	OBL
Bracken Fern	*Pteridium aquilinum*	FACU
New York Fern	*Thelypteris noveboracensis*	FAC
Marsh Fern	*Thelypteris thelypteroides*	FACW+

Forbs

Jack-In-The-Pulpit	*Arisaema triphyllium*	FACW-
Swamp Milkweed	*Asclepias incarnata*	OBL
Aster	*Aster* spp.	
Spotted Wintergreen	*Chimaphila maculata*	UPL
Goldthread	*Coptis trifolia*	FACW
Spotted Joe-Pye-Weed	*Eupatoriadelphus maculatus*	FACW
Boneset	*Eupatorium perfoliatum*	FACW+
Bedstraw	*Galium* spp.	
Hawkweeds	*Hieracium* spp.	UPL
Bluets	*Houstonia* spp.	FAC-FACU
Spotted Jewelweed	*Impatiens capensis*	FACW
Yellow Iris	*Iris pseudoacorus*	OBL
Blueflag Iris	*Iris versicolor*	OBL

Duckweed	*Lemna* spp.	OBL
Bugleweed	*Lycopus virginicus*	OBL
Purple Loosestrife	*Lythrum salicaria*	FACW+
Canada Maylower	*Maianthemum canadense*	FAC-
Water-Millfoil	*Myriophyllum* spp.	OBL
Water Lily	*Nuphar* spp.	OBL
Pale Smartweed	*Polygonum lapathifolium*	FACW+
Pickerelweed	*Pontederia cordata*	OBL
Pondweed	*Potamogeton* spp.	OBL
Swamp Buttercup	*Ranunculus septentrionalis*	OBL
Blackberry	*Rubus* spp.	
Dewberry	*Rubus hispidus*	FACW
Curled Dock	*Rumex crispus*	FACU
Arrowhead	*Saggitaria latifolia*	OBL
Tall Goldenrod	*Solidago altissima*	FACU-
Rough Goldenrod	*Solidago rugosa*	FAC
Skunk Cabbage	*Symplocarpus foetidus*	OBL
Common Cattail	*Typha latifolia*	OBL
Violet	*Viola* spp.	FACW-OBL

<u>Grasses and Grasslike Species</u>

Fringed Sedge	*Carex crinita*	OBL
Broom Sedge	*Carex scoparia*	FACW
Tussock Sedge	*Carex stricta*	OBL
Blunt Broom Sedge	*Carex tribuloides*	FACW+
Other Sedges	*Carex* spp.	FACW-OBL
Spike-Rush	*Eleocharis* spp.	FACW+-OBL
Other Grasses	*Graminaceae*	
Canada Rush	*Juncus canadensis*	OBL
Soft Rush	*Juncus effusus*	FACW+
Rice Cut-Grass	*Leersia oryzoides*	OBL
Haircap Moss	*Polytrichum commune*	FACU**
Sphagnum Moss	*Sphagnum* spp.	OBL**

Category	Symbol	Definition
OBLIGATE HYDROPHYTE	OBL	Nearly always occurs in wetlands (>99%)
FACULTATIVE WETLAND	FACW	Usually occurs in wetlands (67% to 99%)
FACULTATIVE	FAC	Commonly occurs in both wetlands and uplands (34% to 66% in wetlands)
FACULTATIVE UPLAND	FACU	Usually occurs in uplands, but may occasionally occur in wetlands (1% to 33%)
UPLAND	UPL	Nearly always occurs in uplands (<1% in wetlands)

A positive (+) sign behind the Facultative Indicator categories indicates a frequency toward the higher end of the category (more frequently found in wetlands), while a negative (-) sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

D = Dominant (> 50% cover)
C = Common (11%-49% cover)
O = Occasional (1%-10% cover)

* 1988 Wetland Plant List, Northeast Region. National Wetlands Inventory, U.S. Fish and Wildlife Service.

** Indicator status for mosses assigned by experience of NEE personnel; mosses are not rated by Wetland Plant List (1988).

PLOW SHOP POND

Introduction

The Plow Shop Pond wetlands were examined on June 16, 1993 by New England Environmental, Inc. (NEE) biologists. This pond and the adjacent wetlands are located in the northeast corner of the Main Post at Fort Devens, adjacent to the Shepley's Hill Landfill. The pond receives water from Grove Pond and a relatively large upgradient watershed. The Pond drains into Nonacoicus Brook, which eventually discharges into the Nashua River. Plow Shop Pond is an impounded area, with the primary outlet feeding Nonacoicus Brook. Plow Shop Pond is approximately 30 acres in size. This area and the associated wetlands were evaluated by New England Environmental, Inc. as part of a WET evaluation of wetland functional values, and as part of a qualitative evaluation for plant communities, wetland types, and ecological regime. The purpose of this section is to present a qualitative evaluation of the existing wetland system.

Plant Communities

Four major plant communities were observed within Plow Shop Pond and its fringe wetland, although the vast majority of the system is Aquatic Bed. The Emergent Plant Community, Shrub/Scrub type, and Forested Swamp are found in a narrow band which surrounds the Pond. Each of these plant communities is described separately below.

Aquatic Bed Plant Community

The majority of this wetland system is an open water aquatic bed plant community. Much of the area is less than 6.6 feet deep, which helps to describe it as shallow and capable of supporting a dense rooted vascular plant community. Sweet water lily (*Nymphaea odorata*), water shield (*Brasenia schreberi*), duckweed (*Spirodela spp.*), coontail (*Ceratophyllum demersum*), milfoil (*Myriophyllum spp.*), northern arrowhead (*Sagittaria cuneata*), and pickerelweed (*Pontedaria cordata*) were all noted in this community and comprise 80-90% of the plant species present.

Emergent Plant Community

Emergent marsh plants were noted along the majority of the shoreline border. These plants are generally obligate wetland species, with some facultative wetland plant species also present. The following species were noted along the shoreline as part of the emergent plant community: tussock sedge (*Carex stricta*), bugleweed (*Lycopus virginica*), bearded sedge (*Carex comosa*), purple iris (*Iris versicolor*), broadleaf cattail (*Typha latifolia*), yellow iris (*Iris pseudacorus*), eastern burreed (*Sparganium americanum*), soft-stemmed bullrush (*Scirpus validus*), water smartweed (*Polygonum punctatum*), purple loosestrife (*Lythrum salicaria*), and lurid sedge (*Carex lurida*).

Shrub/Scrub Wetland Plant Community

The majority of the wetland fringe around Plow Shop Pond contains a shrub/scrub wetland plant community. This plant community is found in association with many small red maple (*Acer rubrum*) saplings. The shrub/scrub plant community contains the following species: smooth alder (*Alnus serrulata*), speckled alder (*Alnus rugosa*), highbush blueberry (*Vaccinium corymbosum*), maleberry (*Lyonia lingustrina*), swamp azalea (*Rhododendron viscosum*), northern arrow-wood (*Viburnum recognitum*), wild raisin (*Viburnum cassanoides*), mountain holly (*Nemopanthus mucronta*), sheep laurel (*Kalmia angustifolia*), silky dogwood (*Cornus amomum*), ironwood (*Carpinius caroliniana*), witch-hazel (*Hammamelis virginiana*), and winterberry holly (*Ilex verticilata*). The understory of this narrow fringe community contained many species including spotted jewelweed (*Impatiens capensis*), marsh fern (*Thelypteris thelypteroides*), sensitive fern (*Onoclea sensibilis*), cinnamon fern (*Osmunda cinnomomea*), skunk cabbage (*Symplocarpus foetidus*), peat moss (*Sphagnum spp.*), haircap moss (*Polytrichum commune*), staghorn clubmoss (*Lycopodium clavatum*), virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicondendron radicans*).

Forested Swamp Community

In an area adjacent near the pond outlet (Nonacoicus Brook), there is a red maple swamp forested wetland. The overstory is dominated by red maple and gray birch (*Betula populifolia*), and silver maple (*Acer saccharinum*). In the shrub layer wild raisin, nannyberry (*Viburnum lentago*), and highbush blueberry are found. The understory is dominated by cinnamon fern, marsh fern, jewelweed, and joe-pye weed (*Eupatorium maculatum*).

Wildlife Habitat

Although it is beyond the scope of this report to provide a detailed wildlife habitat evaluation of Plow Shop Pond, we are providing a general discussion of the more important wildlife habitats which were evaluated in this study. The approximately 30 acres of open water found in Plow Shop Pond presently provides excellent brood-rearing and migratory feeding habitat for many waterfowl species including black duck, mallard, wood duck, great blue heron, green-backed heron, and canada goose. Although there are suitable nesting areas for waterfowl adjacent to the Pond, we did not observe any waterfowl broods during our one day site visit. The pond area has large areas of aquatic vegetation for forage and brood-rearing by many species of dabbling ducks and geese, and is likely to be heavily used by migrating waterfowl. There is little habitat interspersion or cover within the main body of the pond, which reduces somewhat the habitat value for several waterfowl species (i.e. wood duck), although the several wooded coves and outlet wetland provide additional habitat interspersion.

The Plow Shop Pond wetland system is used by a variety of reptiles and amphibians which were observed within the area including: painted turtle; snapping turtle; northern water snake; bullfrog; and green frog. Although several species of salamanders are likely to occur within this wetland complex, none were observed during our site visit. Mammals observed or which are likely using the area are muskrat, beaver, raccoon, opossum, and northern water shrew. There is some recent sign of beaver activity along the southern edge of the pond, and muskrat were observed in several of the small coves. Raccoon tracks were observed within the wetlands.

The plant community in the wetland and surrounding upland provides good shade, forage, cover, and escape habitat. There are a diverse variety of fruit and mast bearing shrubs and trees (ie. highbush blueberry, red oak), and a good interspersion of plant strata providing nesting, foraging, and breeding habitat for many different bird and mammal species. A very large and important ecotone exists where open water meets forest and shrub areas. As a general assessment, it is our opinion that Plow Shop Pond and the adjacent wetlands presently provides good wildlife habitat for a diverse group of fish and animal species.

The open water area of Plow Shop Pond provides potential habitat for a variety of benthic macroinvertebrates and warm water fish. Water quality is the primary ingredient in determining which species inhabit this environment. The most

likely fish that may be found in this pond, and those which we observed are: golden shiners; yellow bullhead; pumpkinseed; bluegill; large mouth bass; and chain pickerel. Ample evidence exists of fishing in the area (rod-holders, bait cans, trash, bobbers, etc.). There are presently posted warning signs which indicate that Plow Shop Pond is a catch and release area only.

Our site inspection was impressed by the large numbers of nesting bluegills found around almost the entire perimeter of the pond in shallow gravelly substrates. Equally impressive were the large number and the great size of large mouth bass which were observed near the inlet, the outlet, and throughout the aquatic bed.

Observed Impacts

Shepley's Hill Landfill is situated to an area south and adjacent to Plow Shop Pond. Two coves extend from the main body of the Pond towards the landfill, and these coves contain a red precipitate. This precipitate was not observed in any other areas of the Pond. In the northern cove, a steady plume of groundwater was observed to be discharging into the area.

There was a marked contrast of the plant communities within these two coves as compared to the greater body of water of Plow Shop Pond, with a general lack of plant diversity, especially in the northern cove. In addition, several dead trees (white pine and red maples) were observed adjacent to the northern cove. No other obvious tree diebacks were observed around the entire perimeter of Plowshop Pond. The aquatic plant life in the northern cove was sparse and unhealthy in appearance in comparison with the rest of the pond, and much of the aquatic vegetation had absorbed the rust-colored precipitate. Almost all of the pond bottom in the northern cove was rust-colored. Several nesting bluegills were observed within the northern cove.

At the southern cove, similar observations were made, although the observed impacts were less pronounced. At this cove, there was no observed plume of water entering the area, and there was less discoloration. The area did appear to contain a lack of diversity in aquatic plant species. No fish were observed in the southern cove.

Wetland Permits

The wetland Resource Areas around Plow Shop Pond have been previously

delineated and surveyed by another consultant. New England Environmental, Inc. generally agrees with the boundaries as established by the flags in the field, however; only the Ayer Conservation Commission, or the Massachusetts Department of Environmental Protection on appeal, can make the final determination of the extent of the wetlands which are regulated under state law. Similarly, the extent of wetlands which are subject to federal jurisdiction under Section 404 of the Clean Water Act can be determined only by the U.S. Army Corps of Engineers.

Massachusetts Wetlands Protection Act

All wetlands on this site are subject to protection under the Massachusetts Wetlands protection Act. Under the Regulations of the Act, protectable wetlands are broken down into "Resource Areas". According to the Flood Insurance Rate Map (Ayer, MA., Panel 3 of 4), there is a significant area surrounding Plow Shop Pond which is subject to flooding in the 100 year storm event. This area of flooding extends to adjacent areas down stream. The wetland Resource Areas on the site include:

* Land Under a Waterway and Waterbody (Plow Shop Pond and inlet/outlet)
* Bank (the Banks of the Pond and streams)
* Bordering Vegetated Wetland
* Bordering Land Subject to Flooding (100 year floodplain)

The site does not fall within the estimated range of state-listed rare wetlands wildlife according to the 1993 Natural Heritage and Endangered Species Program Atlas.

A wetland filing with the Ayer Conservation Commission will be required for any proposed remediation work. It is likely that any large-scale remediation project can be approved as a Limited Project under section 10.53(4) or perhaps other appropriate sections in the wetlands regulations.

Federal Wetland Jurisdiction under Section 401 of the Clean Water Act

All projects which propose to alter wetlands require Water Quality Certification under Section 401 of the Federal Clean Water Act before work can proceed. Since October 1, 1992 the D.E.P. regions have been administering the 401 Program and now use the state criteria to determine the boundary of wetlands protectable

under 401. If the proposed work will alter in excess of 5,000 square feet of wetlands, then the project will be subject to an alternatives analysis and a more lengthy review process by the D.E.P., and may possibly be denied Certification.

Federal Wetland Jurisdiction under Section 404 of the Clean Water Act

All wetlands on the property are subject to protection under Section 404 of the Clean Water Act. The boundary of wetlands which are protectable under Section 404 is different than that delineated under the Wetlands Protection Act and Section 401 of the Clean Water Act. On this site, it appears that the flagged wetland boundary generally coincides with the line which would have been delineated based solely upon the methodology described in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (1987). This manual describes a multiple parameter methodology which uses the presence of hydric soils, hydrophytic vegetation, and wetland hydrology to establish the boundary of the wetlands. This manual has superseded the more recent *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989) for federal wetland boundary delineations.

TABLE 5: PLANT SPECIES FOUND IN PLOW SHOP POND WETLANDS.

COMMON NAME	SCIENTIFIC NAME	INDICATOR STATUS*
Trees		
Red Maple	*Acer rubrum*	FAC
Silver Maple	*Acer saccharinum*	FACW
Gray Birch	*Betula populifolia*	FAC
Ironwood	*Carpinus caroliniana*	FAC
Red Pine	*Pinus resinosa*	FACU
White Oak	*Quercus alba*	FACU-
Red Oak	*Quercus rubra*	FACU-
American Elm	*Ulmus americana*	FACW-
Shrubs		
Speckled Alder	*Alnus rugosa*	FACW+
Smooth Alder	*Alnus serrulata*	OBL
Common Buttonbush	*Cephalanthus occidentalis*	OBL
Silky Dogwood	*Cornus amomum*	FACW
American Hazelnut	*Corylus americana*	FACU-
Black Huckleberry	*Gaylussacia baccata*	FACU
Witch Hazel	*Hamamelis virginiana*	FAC-
Sheep Laurel	*Kalmia angustifolia*	FAC
Maleberry	*Lyonia ligustrina*	FACW
Sweetgale	*Myrica gale*	OBL
Mountain Holly	*Nemopanthus mucronatus*	OBL
Pink Azalea	*Rhododendron nudiflorum*	FAC
Swamp Azalea	*Rhododendron viscosum*	OBL
Staghorn Sumac	*Rhus typhina*	UPL
Willows	*Salix* spp.	FACW
American Elderberry	*Sambucus canadensis*	FACW-
Meadowsweet	*Spirea latifolia*	FAC+
Steeplebush	*Spirea tomentosa*	FACW
Highbush Blueberry	*Vaccinium corymbosum*	FACW-
Wild Raisin	*Viburnum cassinoides*	FACW

Nannyberry	*Viburnum lentago*	FAC
Northern Arrowwood	*Viburnum recognitum*	FACW-

Ilianas

Virginia Creeper	*Parthenocissus quinquefolia*	FACU
Poison Ivy	*Toxicodendron radicans*	FAC

Ferns

Lady Fern	*Athyrium Filix-femina*	FAC
Spinulose Woodfern	*Dryopteris spinulosa*	FAC+
Staghorn Clubmoss	*Lycopodium clavatum*	FAC
Sensitive Fern	*Onoclea sensibilis*	FACW
Cinnamon Fern	*Osmunda cinnamomea*	FACW
Royal Fern	*Osmunda regalis*	OBL
Bracken Fern	*Pteridium aquilinum*	FACU
New York Fern	*Thelypteris noveboracensis*	FAC

Forbs

Ground Nut	*Apios americana*	FACW
Jack-In-The-Pulpit	*Arisaema triphyllum*	FACW-
Aster	*Aster* spp.	
Bog Hemp	*Boehmeria cylindrica*	FACW+
Water Shield	*Brasenia schreberi*	OBL
Coontail	*Ceratophyllum demersum*	OBL
Goldthread	*Coptis trifolia*	FACW
Spotted Joe-Pye-Weed	*Eupatoriadelphus maculatus*	FACW
Strawberry	*Fragaria virginiana*	FACU
Bedstraw	*Galium* spp.	
Hawkweeds	*Hieracium* spp.	UPL
Bluets	*Houstonia* spp.	FAC-FACU
Spotted Jewelweed	*Impatiens capensis*	FACW
Yellow Iris	*Iris pseudoacorus*	OBL
Blueflag Iris	*Iris versicolor*	OBL
Bugleweed	*Lycopus virginicus*	OBL
Yellow Loosestrife	*Lysimachia terrestris*	OBL
Purple Loosestrife	*Lythrum salicaria*	FACW+

Canada Maylower	*Maianthemum canadense*	FAC-
Water Marigold	*Megalodonta beckii*	OBL
Forget-me-not	*Myosotis scorpioides*	OBL
Water-Millfoil	*Myriophyllum* spp.	OBL
Sweet Water Lily	*Nymphaea odorata*	OBL
Pale Smartweed	*Polygonum lapathifolium*	FACW+
Pickerelweed	*Pontederia cordata*	OBL
Pondweed	*Potamogeton* spp.	OBL
Common Cinquefoil	*Potentilla simplex*	FACU-
Buttercup	*Ranunculus spp.*	FAC-OBL
Blackberry	*Rubus* spp.	
Dewberry	*Rubus hispidus*	FACW
Raspberry	*Rubus* spp.	
Arrowhead	*Saggitaria latifolia*	OBL
Rough Goldenrod	*Solidago rugosa*	FAC
Goldenrod	*Solidago* spp.	
Skunk Cabbage	*Symplocarpus foetidus*	OBL
Common Cattail	*Typha latifolia*	OBL

Mosses and Grass-like Plants

Blue Joint Grass	*Calamagrostis canadensis*	FACW+
Fringed Sedge	*Carex crinita*	OBL
Lurid Sedge	*Carex lurida*	OBL
Broom Sedge	*Carex scoparia*	FACW
Stalk-Grain Sedge	*Carex stipata*	OBL
Tussock Sedge	*Carex stricta*	OBL
Blunt Broom Sedge	*Carex tribuloides*	FACW+
Other Sedges	*Carex* spp.	FACW-OBL
Other Grasses	*Graminaceae*	
Timothy	*Phleum pratense*	FACU
Flat Bluegrass	*Poa compressa*	
Haircap Moss	*Polytrichum commune*	FACU**
Softstem Bulrush	*Scirpus validus*	OBL
Bur Reed	*Sparganium* spp.	OBL
Sphagnum Moss	*Sphagnum* spp.	OBL**

Category	Symbol	Definition
OBLIGATE HYDROPHYTE	OBL	Nearly always occurs in wetlands (>99%)
FACULTATIVE WETLAND	FACW	Usually occurs in wetlands (67% to 99%)
FACULTATIVE	FAC	Commonly occurs in both wetlands and uplands (34% to 66% in wetlands)
FACULTATIVE UPLAND	FACU	Usually occurs in uplands, but may occasionally occur in wetlands (1% to 33%)
UPLAND	UPL	Nearly always occurs in uplands (<1% in wetlands)

A positive (+) sign behind the Facultative Indicator categories indicates a frequency toward the higher end of the category (more frequently found in wetlands), while a negative (-) sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

D = Dominant (> 50% cover)
C = Common (11%-49% cover)
O = Occasional (1%-10% cover)

* 1988 Wetland Plant List, Northeast Region. National Wetlands Inventory, U.S. Fish and Wildlife Service.

** Indicator status for mosses assigned by experience of NEE personnel; mosses are not rated by Wetland Plant List (1988).

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APPENDIX E

WET DATA FORMS

WET - COLDSPRIN

FORM A: SITE DOCUMENTATION (Page 1 of 2)

Part 1 - Background Information AA I

Evaluation Site: COLD SPRING POND Date: 6-18-93

Site Location (Section, Range, and Township): AYER

Has the evaluator taken a training course in WET Version 2.0? YES

Agencies/Experts Contacted: SCS, NOAA, MA F+W, NAT. HERITAGE

Circle the assessment levels to be completed? SS-1 SS-2 E/O-1&2 E/O-3 HS

Is the wetland tidal or nontidal? If the wetland is nontidal, indicate the month(s) that represent wet, dry, and average conditions, or if only average annual condition will be used, give rationale. Also, indicate if the previous 12 months of precipitation has been above, below, or near normal.

Nontidal Wet Cond. - [illegible] - March, Veg - May; Dry Cond. [illegible] - Hydrology - Aug. Veg - [illegible] Ave. Cond - [illegible] - June, Veg - Sept.

Is this evaluation an estimate of past conditions or a prediction of future conditions? (If answer is yes, explain nature and source of predictive data.) NO

Will alternative ratings be used to evaluate any of the functions or values (if yes, explain)? NO

Part 2 - Identification and Delineation of Evaluation Areas

Sketch a map on the following page, or attach a suitable map (photocopy of topgraphic map) that shows the following information: SEE FIGURE 1

- -- Boundaries of the AA, IA, and IZ, and the location of service areas.
- -- Watershed boundaries of AA, and service areas.
- -- Extent of surface water in the AA during the wet and dry seasons.
- -- Open water (channels and pools) within and adjacent to the AA.
- -- Normal direction of channel or tidal flow
- -- Normal direction of wind-driven waves or current.
- -- Impact area(s).
- -- Scale of distance and north compass direction.

Explain the procedures used to identify or delineate the AA, IA, IZ, service areas, and the watersheds of these areas if they differed from the guidelines outlined in Section 2.7. N/A

-- Continued --

FORM A: SITE DOCUMENTATION (Page 2 of 2)

Part 2 (Cont.)

Estimate the extent of the following areas:

Assessment Area = ±3 acres
Impact Area = N/A acres (only if applicable)
Watershed of AA = ±50 acres/ 0.08 miles^2 (acres x 0.0016 = miles)
Wetlands in AA = ±3 acres
Wetlands in the watershed of closest service area = >500 acres
Wetlands and deepwater in the watershed of closest service area = >500 acres

How were locality and region defined for this evaluation?
locality - Town (Ayer)
Region - State (Massachusetts)

Sketch of Evaluation Areas (or attach map):

See Figure 1

FORM B: EVALUATION ANSWER SHEET

Evaluation Site: Cold Spring Pond AA-1

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 1

3.1.1 "Red Flags"

				Comments/Assumptions
s1.	Y	N	U	NOT LISTED BY MA. NAT. HERITAGE
s2.	Y	N	U	
s3.	Y	N	U	
s4.	Y	N	U	
s5.	Y	N	U	
s6.	Y	N	U	

3.1.2 On-site Social Significance

					Comments/Assumptions
s7.	Y	N	U	I	
s8.	Y	N	U	I	- SUPERFUND SITE

3.1.3 Off-site Social Significance

					Comments
s9.	Y	N	U	I	
s10.	Y	N	U		
s11.	Y	N	U		
s12.	Y	N	U		
s13.	Y	N	U		
s14.	Y	N	U		
s15.	Y	N	U	I	· ESTIMATED HABITAT MAP
s16.	Y	N	U	I	· GROVE POND WELL FIELD
s17.	Y	N	U	I	
s18.	Y	N	U	I	
s19.	Y	N	U		
s20.	Y	N	U		NO IMPORTANT FISH

					Comments
s21.	Y	N	U		BLACK DUCK/WOOD DUCK
s22.	Y	N	U	I	
s23.	Y	N	U		
s24.	Y	N	U		
s25.	Y	N	U		[illegible]
s26.	Y	N	U		
s27.	Y	N	U		NO LOCAL [illegible]
s28.	Y	N	U		
s29.	Y	N	U		- [illegible]
s30.	Y	N	U		
s31.	Y	N	U		- [illegible]

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 2

Context Region (Circle one)
- Standard Density Circle
- Locality
- Hydrologic Unit

Question #			Comments/Assumptions
1	Y	N	- [illegible]
2	Y	N	[illegible]
3	Y	N	- [illegible] FLOOD [illegible]
4	Y	N	- FLO[illegible]

FORM B (Cont.)

Evaluation Site: Cold [illegible]

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 1 (OFFICE)

Q.#	X̄	W	D	COMMENTS/ASSUMPTIONS
1.1	Y N			
1.2	Y N - [illegible] SCS			
1.3	Y N			
2.1.1	Y N			
2.1.2	Y N			
2.1.3	Y N			
2.2.1	Y N I			
2.2.2	Y N I		[illegible] FIELD [illegible]	
3.1	Y N			
3.2	Y N NWI MAPS			
3.3	Y N NWI MAPS			
4.1	Y N - NASHUA/MERRIMACK RIVER			
4.2A	Y N - USGS			
4.2B	Y N			
4.2C	Y N			
4.2D	Y N			
5.1.1		Y N		
5.1.2		Y N		
5.2		Y N		
6.1	Y N USGS			
6.2	Y N FIELD INVESTIGATION			
7	Y N I			
8.1	Y N - FIELD OBS			
8.2	Y N			
8.3	Y N - USGS & FIELD			
8.4	Y N			
9.1		Y N - CONSTRICTED OUTLET		
9.2		Y N I		
9.3		Y N I - GNDWATER DIS		
10A	Y N - AQUATIC BED			
10B	Y N			
10C	Y N			
10D	Y N			
10E	Y N			
10F	Y N			

Evaluation Site: COLD SPRING - AA 1

WETLAND CONDITION

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
11	Y N	Y N	Y N	
12A	Y N	Y N	Y N	DOMINANT A - AQUATIC BED, ROOTED VASCULAR
12Aa	Y N	Y N	Y N	
12Ab	Y N	Y N	Y N	
12Ac	Y N	Y N	Y N	
12Ad	Y N	Y N	Y N	
12Ae	Y N	Y N	Y N	EDGE B - SHRUB/SCRUB BROAD LEAF DECIDUOUS
12B	Y N	Y N	Y N	
12Ba	Y N	Y N	Y N	
12Bb	Y N	Y N	Y N	C - AQUATIC BED, ROOTED VASCULAR
12Bc	Y N	Y N	Y N	
12Bd	Y N	Y N	Y N	
12Be	Y N	Y N	Y N	
12C	Y N	Y N	Y N	
12Ca	Y N	Y N	Y N	
12Cb	Y N	Y N	Y N	
12Cc	Y N	Y N	Y N	
12Cd	Y N	Y N	Y N	
12D	Y N	Y N	Y N	
12Da	Y N	Y N	Y N	
12Db	Y N	Y N	Y N	
12E	Y N	Y N	Y N	
13A	Y N	Y N	Y N	>10% - AQUATIC BE
13Aa	Y N	Y N	Y N	> 10% - FORESTED BE
13Ab	Y N	Y N	Y N	> 10% - SHRUB/SCRUB
13Ac	Y N	Y N	Y N	
13Ad	Y N	Y N	Y N	
13Ae	Y N	Y N	Y N	
13B	Y N	Y N	Y N	
13Ba	Y N	Y N	Y N	
13Bb	Y N	Y N	Y N	
13Bc	Y N	Y N	Y N	
13Bd	Y N	Y N	Y N	
13Be	Y N	Y N	Y N	
13C	Y N	Y N	Y N	
13Ca	Y N	Y N	Y N	
13Cb	Y N	Y N	Y N	
13Cc	Y N	Y N	Y N	
13Cd	Y N	Y N	Y N	
13D	Y N	Y N	Y N	
13Da	Y N	Y N	Y N	
13Db	Y N	Y N	Y N	
13E	Y N	Y N	Y N	

FORM B (Cont.)

Evaluation Site: COLD SPRING POND - AA 1

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
	WETLAND CONDITION			
14.1	Y N	Y N	Y N	FIELD OBSERV.
14.2	Y N	Y N	Y N	
15.1A	Y N I			
15.1B	Y N I	FIELD OBSERV.		
15.1C	Y N I			
15.2	Y N I	NO CHANNEL FLOW		
16A	Y N	Y N	Y N	FIELD OBSERV.
16B	Y N	Y N	Y N	
16C	Y N	Y N	Y N	
17	Y N	<70% ANY CLASS		
18	Y N I			
19.1A	Y N I - TREES, TOPO			
19.1B	Y N I			
19.2	Y N I			
19.3	Y N I			
20.1	Y N I			
20.2	Y N I			
21A	Y N - MOSTLY FORESTED THROUGH SIG. LANDFILL AREA			
21B	Y N			
21C	Y N			
21D	Y N			
21E	Y N			
22.1.1	Y N			
22.1.2	Y N I			
22.2	Y N			
22.3	Y N I			
23	Y N CONSTRICTING CULVERTS			
24.1	Y N I - SCS SOILS MAP			
24.2	Y N I			
24.3	Y N I			
24.4	Y N I			
24.5	Y N			
25.1	Y N - LANDFILL			
25.2A	Y N I			
25.2B	Y N I			
25.3	Y N - UNSTABLE SOILS			

FORM B (Cont.)

Evaluation Site: COLD SPRING POND AA 1

WETLAND CONDITION — COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
26.1	Y N – LANDFILL			
26.2	Y N I – GRNDWTR DISCH.			
26.3	Y N. I – CHANNEL FROM UPGRADIENT AA			
27.1	Y N LANDFILL			
27.2	Y N I			
27.3	Y N I CHANNEL FROM UPGRADIENT AA			

EFFECTIVENESS/OPPORTUNITY EVALUATION – LEVEL 2 (FIELD)

WETLAND CONDITION — COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
28	Y N			
29.1	Y N SHRUBS ON AA [illegible]			
29.2	Y N 7%			
30.	Y N	Y N	Y N	
31.1	Y N	Y N	Y N	
31.2	Y N	Y N	Y N	
31.3	Y N	Y N	Y N	
31.4	Y N I	Y N I	Y N I	– WINTER
31.5	Y N	Y N	Y N	
31.6A	Y N	Y N	Y N	
31.6B	Y N	Y N	Y N	
31.6C	Y N	Y N	Y N	
31.6D	Y N	Y N	Y N	
31.6E	Y N	Y N	Y N	
32A	Y N			
32B	Y N			
32C	Y N			
32D	Y N			
32E	Y N			
32F	Y N			
32G	Y N			
32H	Y N			
32I	Y N			
32J	Y N			
32K	Y N			

FORM B (Cont.)

Evaluation Site: COLD SPRING POND AA1

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
33A	Y N			
33B	Y N			
33C	Y N			
33D	Y N			
33E	Y N			
33F	Y N			
33G	Y N			
33H	Y N			
33I	Y N			
33J	Y N			
33K	Y N			
34.1	Y N			- USGS - OBSERVED FIELD DATA
34.2	Y N			
34.3.1	Y N			
34.3.2	Y N I			
35.1	Y N I			FEMA MAP, FIELD OBSERV
35.2	Y N I			
36.1.1	Y N	Y N	Y N	
36.1.2	Y N	Y N	Y N	
36.2.1	Y N	Y N	Y N	
36.2.2	Y N	Y N	Y N	- CATTAILS TUSSOCK SEDGE
36.2.3	Y N	Y N	Y N	
37	Y N			
38.1	Y N			- UPGRADIENT AA
38.2	Y N			
38.3	Y N			
38.4	Y N			
38.5	Y N			
38.6	Y N			
38.7	Y N			- NWI MAPS
38.8	Y N I			
39	Y N			
40.1	Y N I			
40.2	Y N I			
41.1		Y N I		
41.2		Y N I		

FORM B (Cont.)

Evaluation Site: Cold Spring Bro[illegible] AA-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
42.1.1	Y N I	Y N I	Y N I
42.1.2	Y N I	Y N I	Y N I
42.1.3	Y N I	Y N I	Y N I
42.2.1	Y N I	Y N I	Y N I
42.2.2	Y N I	Y N I	Y N I
42.2.3	Y N I	Y N I	Y N I
43A	Y N	Y N	Y N
43B	Y N	Y N	Y N
43C	Y N	Y N	Y N
43D	Y N	Y N	Y N
43E	Y N	Y N	Y N
43F	Y N	Y N	Y N
43G	Y N	Y N	Y N
43H	Y N	Y N	Y N
43I	Y N	Y N	Y N
44A	Y N	Y N	Y N
44B	Y N	Y N	Y N
44C	Y N	Y N	Y N
44D	Y N	Y N	Y N
44E	Y N	Y N	Y N
44F	Y N	Y N	Y N
44G	Y N	Y N	Y N
44H	Y N	Y N	Y N
44I	Y N	Y N	Y N
45A	Y N		
45B	Y N		
45C	Y N		
45D	Y N		
45E	Y N		
45F	Y N		
45G	Y N		
46A	Y N	Y N	Y N
46B	Y N	Y N	Y N
46C	Y N	Y N	Y N
47A	Y N		
47B	Y N		
47C	Y N		

FORM B (Cont.)

Evaluation Site: Cold Spring Pond AA1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
48A	Y N I	Y N I	Y N I
48B	Y N I	Y N I	Y N I
48C	Y N I	Y N I	Y N I
48D	Y N I	Y N I	Y N I
48E	Y N I	Y N I	Y N I
48F	Y N I	Y N I	Y N I
49.1.1	Y N I	Y N I	Y N I
49.1.2	Y N I	Y N I	Y N I
49.2	Y N I	Y N I	Y N I
49.3	Y N I	Y N I	Y N I
50.	Y N	Y N	Y N

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 3 (DETAILED DATA)

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
51.1	Y N U		
51.2	Y N U		
52.1	Y N I U		
52.2	Y N I U		
53.1	Y N I U		
53.2	Y N I U		
54	Y N U	Y N U	Y N U
55.1	Y N U		
55.2	Y N U		
55.3	Y N U		
55.4	Y N U		
56.1	Y N I U		
56.2	Y N I U		
57.1	Y N U		
57.2	Y N U		
58.	Y N U		

FORM B (Cont.)

Evaluation Site: ______________________

WETLAND CONDITION					COMMENTS/ASSUMPTIONS
Q.#	$\bar{X}$	W	D		
59.1	Y N I U				
59.2	Y N I U				
60	Y N U				
61	Y N I U				
62	Y N U				
63.1	Y N I U				
63.2	Y N I U				
64		Y N I U			

FORM C: SUPPLEMENTARY OBSERVATIONS

Evaluation Site: Cold Spring Pond AA#1

Indicate the species, species groups, and activities that are actually observed, reliably reported, or known to occur at the AA on a regular basis.

FISH SPECIES GROUPS*	OBSERVED/REPORTED
1. Warmwater Group	Y or N
2. Coldwater Group	Y or N
3. Northern Lake Group	Y or N
4. Coldwater Riverine Group	Y or N

FISH SPECIES	OBSERVED/REPORTED
22 [illegible] 26 Pumpkinseed n	Y or N
10 [illegible]	Y or N
7 Smallmouth Bass	Y or N
40 Redbreasted Sunfish N	

WATERFOWL SPECIES GROUPS**

	OBSERVED/REPORTED		
	NESTING	MIGRATING	WINTERING
1. Prairie Dabblers	110 Y or N	Y or N	Y or N
2. Black Duck	113 Y or N	Y or N	Y or N
3. Wood Duck	118 Y or N	Y or N	Y or N
4. Common and Red-Breasted Mergansers	119 Y or N	Y or N	Y or N
5. Hooded Merganser	122 Y or N	Y or N	Y or N
6. Canvasback, Redhead, Ruddy Duck	125 Y or N	Y or N	Y or N
7. Ring-necked Duck	128 Y or N	Y or N	Y or N
8. Greater and Lesser Scaup	151 Y or N	Y or N	Y or N
9. Common Goldeneye	134 Y or N	Y or N	Y or N
10. Bufflehead	137 Y or N	Y or N	Y or N
11. Whistling Ducks	140 Y or N	Y or N	Y or N
12. Inland Geese	143 Y or N	Y or N	Y or N
13. Tundra Swan	146 Y or N	Y or N	Y or N
14. Brant	149 Y or N	Y or N	Y or N

[illegible]

BIRD SPECIES	OBSERVED/REPORTED
✓ [illegible]	Y or N
✓ [illegible]	Y or N
✓ Green Heron	Y or N

RECREATIONAL ACTIVITIES

Hiking	Sailing	Snowmobiling	Research
Birdwatching	Power Boating	Skiing	Educational Fieldtrips
Photography	Canoeing	Snowshoeing	Horseback Riding
Swimming	Kayaking	Ice Skating	

CONSUMPTIVE ACTIVITIES

[illegible]

Agriculture	Fur Harvesting	Commercial/Sport Fishing	Peat Harvesting
Hunting	Timber Harvest	Natural Food Gathering	Water Supply

[illegible]

* Fish species groups are explained on page 138
** Waterfowl species groups are explained on page 1647

FORM D: EVALUATION SUMMARY SHEET

Evaluation Site: ______________________

Wetland Functions and Values

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge			*
Ground Water Discharge			*
Floodflow Alteration			
Sediment Stabilization			*
Sediment/Toxicant Retention			
Nutrient Removal/Transform.			
Production Export	*		*
Wildlife Diversity/Abundance**		*	*
Breeding	*		*
Migration	*		*
Wintering	*		*
Aquatic Diversity/Abundance			*
Uniqueness/Heritage		*	*
Recreation		*	*

Habitat Suitability Evaluation

Fish Species Groups:

__________ Group ___ __________ Group ___ __________ Group ___

Waterfowl Species Groups:

	Breeding	Migration	Wintering
Group ______	___	___	___
Group ______	___	___	___
Group ______	___	___	___
Group ______	___	___	___

Fish, Invertebrate, and Bird Species:

______	___	______	___	______	___
______	___	______	___	______	___
______	___	______	___	______	___
______	___	______	___	______	___

Levels of assessment completed: S-1 S-2 E/O-1 E/O-2 E/O-3 HS
Evaluation is for the: AA IA (Note: if the evaluation is for an IA, documentation of the AA evaluation must be presented with this evaluation).
Is there any evidence that suggests ratings contrary to the above (explain)?
____
Were alternative sources used for any of the ratings above (explain)? ______
____
The loss rate for ______________ (identify locality/region) between 19__ and 19__ for ______________ (identify wetland type) was ________ (acres/year or % loss).

* WET does not evaluate this function or value in these terms.
** Wildlife Diversity/Abundance assesses only wetland-dependent birds. Other wildlife (e.g., game mammals) should be evaluated using other methods.

POST PLOW

FORM A: SITE DOCUMENTATION (Page 1 of 2)

Part 1 - Background Information

Evaluation Site: PLOWSHOP POND IA 2 POST IMPACT - 3 yrs Date: 6/21/93

Site Location (Section, Range, and Township): AYER MA

Has the evaluator taken a training course in WET Version 2.0? Yes

Agencies/Experts Contacted: SCS NOAA

Circle the assessment levels to be completed? SS-1 SS-2 E/O-1&2 E/O-3 HS

Is the wetland tidal or nontidal? If the wetland is nontidal, indicate the month(s) that represent wet, dry, and average conditions, or if only average annual condition will be used, give rationale. Also, indicate if the previous 12 months of precipitation has been above, below, or near normal.
Nontidal, Wet Cond - hydrology - March Veget - May Dry Cond - Hydrol - [illegible] Veg - NOV. [illegible] Avg Cond - Hydrol [illegible] Veg. Sept.

Is this evaluation an estimate of past conditions or a prediction of future conditions? (If answer is yes, explain nature and source of predictive data.)
No

Will alternative ratings be used to evaluate any of the functions or values (if yes, explain)? No

Part 2 - Identification and Delineation of Evaluation Areas

Sketch a map on the following page, or attach a suitable map (photocopy of topgraphic map) that shows the following information:

- Boundaries of the AA, IA, and IZ, and the location of service areas. See Figure
- Watershed boundaries of AA, and service areas.
- Extent of surface water in the AA during the wet and dry seasons.
- Open water (channels and pools) within and adjacent to the AA.
- Normal direction of channel or tidal flow
- Normal direction of wind-driven waves or current.
- Impact area(s).
- Scale of distance and north compass direction.

Explain the procedures used to identify or delineate the AA, IA, IZ, service areas, and the watersheds of these areas if they differed from the guidelines outlined in Section 2.7. N/A

-- Continued --

FORM A: SITE DOCUMENTATION (Page 2 of 2)

Part 2 (Cont.)

Estimate the extent of the following areas:

Assessment Area = N/A acres
Impact Area = ±25 acres (only if applicable)
Watershed of AA = — acres/±25 miles^2 (acres x 0.0016 = miles)
Wetlands in AA = ±25 acres
Wetlands in the watershed of closest service area = >500 acres
Wetlands and deepwater in the watershed of closest service area = >500 acres

How were locality and region defined for this evaluation?

Locality - Town (Ayer)
Region - State (Massachusetts)

Sketch of Evaluation Areas (or attach map):

See Figure 1.

FORM B: EVALUATION ANSWER SHEET

Evaluation Site: Plowshop Pond I A-2

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 1

3.1.1 "Red Flags"

Comments/Assumptions

s1. Y N U
s2. Y N U
s3. Y N U
s4. Y N U
s5. Y N U
s6. Y N U

3.1.2 On-site Social Significance

Comments/Assumptions

s7. Y N U I
s8. Y N U I — Superfund site

3.1.3 Off-site Social Significance

Comments

s9. Y N U I — "Y" s10
s10. Y N U — ch. due to
s11. Y N U — <10% & open
s12. Y N U — water 77%
s13. Y N U
s14. Y N U
s15. Y N U I
s16. Y N U I
s17. Y N U I
s18. Y N U I
s19. Y N U
s20. Y N U

Comments

s21. Y N U
s22. Y N U I
s23. Y N U
s24. Y N U
s25. Y N U — Superfund.
s26. Y N U — No SCEP, no dig.
s27. Y N U
s28. Y N U
s29. Y N U
s30. Y N U
s31. Y N U

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 2

Context Region (Circle one)

Standard Density Circle
Locality
Hydrologic Unit

Question #

Comments/Assumptions

1 Y N — Same as 4A
2 Y N
3 Y N
4 Y N

FORM B (Cont.)

Evaluation Site: Plowshop IA - 2

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 1 (OFFICE)

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
1.1	Y N			
1.2	Y N			
1.3	Y N			
2.1.1	Y N			
2.1.2	Y N			
2.1.3	Y N			
2.2.1	Y N I			
2.2.2	Y N I			
3.1	Y N			
3.2	Y N			
3.3	Y N			
4.1	Y N - [illegible]			
4.2A	Y N			
4.2B	Y N			
4.2C	Y N			
4.2D	Y N			
5.1.1		Y N		
5.1.2		Y N		
5.2		Y N		
6.1	Y N			
6.2	Y N			
7	Y N I			
8.1	Y N			
8.2	Y N			
8.3	Y N			
8.4	Y N			
9.1		Y N		
9.2		Y N I		
9.3		Y N I		
10A	Y N			
10B	Y N			
10C	Y N			
10D	Y N			
10E	Y N			
10F	Y N			

FORM B (Cont.)

Evaluation Site: Ploughshare IA-2

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
11	Y N	Y N	Y N
12A	Y N	Y N	Y N
12Aa	Y N	Y N	Y N
12Ab	Y N	Y N	Y N
12Ac	Y N	Y N	Y N
12Ad	Y N	Y N	Y N
12Ae	Y N	Y N	Y N
12B	Y N	Y N	Y N
12Ba	Y N	Y N	Y N
12Bb	Y N	Y N	Y N
12Bc	Y N	Y N	Y N
12Bd	Y N	Y N	Y N
12Be	Y N	Y N	Y N
12C	Y N	Y N	Y N
12Ca	Y N	Y N	Y N
12Cb	Y N	Y N	Y N
12Cc	Y N	Y N	Y N
12Cd	Y N	Y N	Y N
12D	Y N	Y N	Y N
12Da	Y N	Y N	Y N
12Db	Y N	Y N	Y N
12E	Y N	Y N	Y N
13A	Y N	Y N	Y N
13Aa	Y N	Y N	Y N
13Ab	Y N	Y N	Y N
13Ac	Y N	Y N	Y N
13Ad	Y N	Y N	Y N
13Ae	Y N	Y N	Y N
13B	Y N	Y N	Y N
13Ba	Y N	Y N	Y N
13Bb	Y N	Y N	Y N
13Bc	Y N	Y N	Y N
13Bd	Y N	Y N	Y N
13Be	Y N	Y N	Y N
13C	Y N	Y N	Y N
13Ca	Y N	Y N	Y N
13Cb	Y N	Y N	Y N
13Cc	Y N	Y N	Y N
13Cd	Y N	Y N	Y N
13D	Y N	Y N	Y N
13Da	Y N	Y N	Y N
13Db	Y N	Y N	Y N
13E	Y N	Y N	Y N

FORM B (Cont.)

Evaluation Site: Plowshop IA-7

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
14.1	Y N	Y N	Y N
14.2	Y N	Y N	Y N
15.1A	Y N I		
15.1B	Y N I		
15.1C	Y N I		
15.2	Y N I		
16A	Y N	Y N	Y N
16B	Y N	Y N	Y N
16C	Y N	Y N	Y N
17	Y N		
18	Y N I		
19.1A	Y N I		
19.1B	Y N I		
19.2	Y N I		
19.3	Y N I		
20.1	Y N I		
20.2	Y N I		
21A	Y N		
21B	Y N		
21C	Y N		
21D	Y N		
21E	Y N		
22.1.1	Y N		
22.1.2	Y N I		
22.2	Y N		
22.3	Y N I		
23	Y N		
24.1	Y N I		
24.2	Y N I		
24.3	Y N I		
24.4	Y N I		
24.5	Y N		
25.1	Y N		
25.2A	Y N I		
25.2B	Y N I		
25.3	Y N		

FORM B (Cont.)

Evaluation Site: Cold Springs IH-2

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
26.1	Y N		
26.2	Y N I		
26.3	Y N I		
27.1	Y N		
27.2	Y N I		
27.3	Y N I		

EFFECTIVENESS/OPPORTUNITY EVALUATION – LEVEL 2 (FIELD)

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
28	Y N		
29.1	Y N		
29.2	Y N		
30.	Y N	Y N	Y N
31.1	Y N	Y N	Y N
31.2	Y N	Y N	Y N
31.3	Y N	Y N	Y N
31.4	Y N I	Y N I	Y N I
31.5	Y N	Y N	Y N
31.6A	Y N	Y N	Y N
31.6B	Y N	Y N	Y N
31.6C	Y N	Y N	Y N
31.6D	Y N	Y N	Y N
31.6E	Y N	Y N	Y N
32A	Y N		
32B	Y N		
32C	Y N		
32D	Y N		
32E	Y N		
32F	Y N		
32G	Y N		
32H	Y N		
32I	Y N		
32J	Y N		
32K	Y N		

FORM B (Cont.)

Evaluation Site: Flowshop I-A-2

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
33A	Y N		
33B	Y N		
33C	Y N		
33D	Y N		
33E	Y N		
33F	Y N		
33G	Y N		
33H	Y N		
33I	Y N		
33J	Y N		
33K	Y N		
34.1	Y N		
34.2	Y N		
34.3.1	Y N		
34.3.2	Y N I		
35.1	Y N I		
35.2	Y N I		
36.1.1	Y N	Y N	Y N
36.1.2	Y N	Y N	Y N
36.2.1	Y N	Y N	Y N
36.2.2	Y N	Y N	Y N
36.2.3	Y N	Y N	Y N
37	Y N		
38.1	Y N		
38.2	Y N		
38.3	Y N		
38.4	Y N		
38.5	Y N		
38.6	Y N		
38.7	Y N		
38.8	Y N I		
39	Y N		
40.1	Y N I		
40.2	Y N I		
41.1		Y N I	
41.2		Y N I	

FORM B (Cont.)

Evaluation Site: Plowshop I + 2

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
42.1.1	Y N I	Y N I	Y N I	
42.1.2	Y N I	Y N I	Y N I	
42.1.3	Y N I	Y N I	Y N I	
42.2.1	Y N I	Y N I	Y N I	
42.2.2	Y N I	Y N I	Y N I	
42.2.3	Y N I	Y N I	Y N I	
43A	Y N	Y N	Y N	
43B	Y N	Y N	Y N	
43C	Y N	Y N	Y N	
43D	Y N	Y N	Y N	
43E	Y N	Y N	Y N	
43F	Y N	Y N	Y N	
43G	Y N	Y N	Y N	
43H	Y N	Y N	Y N	
43I	Y N	Y N	Y N	
44A	Y N	Y N	Y N	
44B	Y N	Y N	Y N	
44C	Y N	Y N	Y N	
44D	Y N	Y N	Y N	
44E	Y N	Y N	Y N	
44F	Y N	Y N	Y N	
44G	Y N	Y N	Y N	
44H	Y N	Y N	Y N	
44I	Y N	Y N	Y N	
45A	Y N			
45B	Y N			
45C	Y N			
45D	Y N	– assumed reduced [illegible] in maj. of area		
45E	Y N			
45F	Y N			
45G	Y N			
46A	Y N	Y N	Y N	
46B	Y N	Y N	Y N	
46C	Y N	Y N	Y N	
47A	Y N			
47B	Y N			
47C	Y N			

FORM B (Cont.)

Evaluation Site: Plowshop AA2

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
48A	Y N I	Y N I	Y N I
48B	Y N I	Y N I	Y N I
48C	Y N I	Y N I	Y N I
48D	Y N I	Y N I	Y N I
48E	Y N I	Y N I	Y N I
48F	Y N I	Y N I	Y N I
49.1.1	Y N I	Y N I	Y N I
49.1.2	Y N I	Y N I	Y N I
49.2	Y N I	Y N I	Y N I
49.3	Y N I	Y N I	Y N I
50.	Y N	Y N	Y N

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 3 (DETAILED DATA)

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
51.1	Y N U		
51.2	Y N U		
52.1	Y N I U		
52.2	Y N I U		
53.1	Y N I U		
53.2	Y N I U		
54	Y N U	Y N U	Y N U
55.1	Y N U		
55.2	Y N U		
55.3	Y N U		
55.4	Y N U		
56.1	Y N I U		
56.2	Y N I U		
57.1	Y N U		
57.2	Y N U		
58.	Y N U		

FORM B (Cont.)

Evaluation Site: ______________________________

	WETLAND CONDITION			COMMENTS/ASSUMPTIONS
Q.#	$\bar{X}$	W	D	
59.1	Y N I U			
59.2	Y N I U			
60	Y N U			
61	Y N I U			
62	Y N U			
63.1	Y N I U			
63.2	Y N I U			
64		Y N I U		

FORM C: SUPPLEMENTARY OBSERVATIONS

Evaluation Site: ______________________________

Indicate the species, species groups, and activities that are actually observed, reliably reported, or known to occur at the AA on a regular basis.

FISH SPECIES GROUPS*	OBSERVED/REPORTED
1. Warmwater Group	Y or N
2. Coldwater Group	Y or N
3. Northern Lake Group	Y or N
4. Coldwater Riverine Group	Y or N

FISH SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

WATERFOWL SPECIES GROUPS**	OBSERVED/REPORTED		
	NESTING	MIGRATING	WINTERING
1. Prairie Dabblers	Y or N	Y or N	Y or N
2. Black Duck	Y or N	Y or N	Y or N
3. Wood Duck	Y or N	Y or N	Y or N
4. Common and Red-Breasted Mergansers	Y or N	Y or N	Y or N
5. Hooded Merganser	Y or N	Y or N	Y or N
6. Canvasback, Redhead, Ruddy Duck	Y or N	Y or N	Y or N
7. Ring-necked Duck	Y or N	Y or N	Y or N
8. Greater and Lesser Scaup	Y or N	Y or N	Y or N
9. Common Goldeneye	Y or N	Y or N	Y or N
10. Bufflehead	Y or N	Y or N	Y or N
11. Whistling Ducks	Y or N	Y or N	Y or N
12. Inland Geese	Y or N	Y or N	Y or N
13. Tundra Swan	Y or N	Y or N	Y or N
14. Brant	Y or N	Y or N	Y or N

BIRD SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

RECREATIONAL ACTIVITIES

Hiking	Sailing	Snowmobiling	Research
Birdwatching	Power Boating	Skiing	Educational Fieldtrips
Photography	Canoeing	Snowshoeing	Horseback Riding
Swimming	Kayaking	Ice Skating	

CONSUMPTIVE ACTIVITIES

Agriculture	Fur Harvesting	Commercial/Sport Fishing	Peat Harvesting
Hunting	Timber Harvest	Natural Food Gathering	Water Supply

* Fish species groups are explained on page 138
** Waterfowl species groups are explained on page 1647

FORM D: EVALUATION SUMMARY SHEET

Evaluation Site: ______________________________

Wetland Functions and Values

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge			*
Ground Water Discharge			*
Floodflow Alteration			
Sediment Stabilization			*
Sediment/Toxicant Retention			
Nutrient Removal/Transform.			
Production Export	*		*
Wildlife Diversity/Abundance**		*	*
Breeding	*		*
Migration	*		*
Wintering	*		*
Aquatic Diversity/Abundance			*
Uniqueness/Heritage		*	*
Recreation		*	*

Habitat Suitability Evaluation

Fish Species Groups:

__________ Group ___ __________ Group ___ __________ Group ___

Waterfowl Species Groups:

	Breeding	Migration	Wintering
Group __________	___	___	___
Group __________	___	___	___
Group __________	___	___	___
Group __________	___	___	___

Fish, Invertebrate, and Bird Species:

__________ ___ __________ ___ __________ ___
__________ ___ __________ ___ __________ ___
__________ ___ __________ ___ __________ ___
__________ ___ __________ ___ __________ ___

Levels of assessment completed: S-1 S-2 E/O-1 E/O-2 E/O-3 HS
Evaluation is for the: AA IA (Note: if the evaluation is for an IA, documentation of the AA evaluation must be presented with this evaluation).
Is there any evidence that suggests ratings contrary to the above (explain)?
____
Were alternative sources used for any of the ratings above (explain)? __________
____
The loss rate for ______________________________ (identify locality/region) between 19__ and 19__ for ______________________________ (identify wetland type) was __________ (acres/year or % loss).

* WET does not evaluate this function or value in these terms.
** Wildlife Diversity/Abundance assesses only wetland-dependent birds. Other wildlife (e.g., game mammals) should be evaluated using other methods.

DATA NAME: PLOWSHOP

FORM A: SITE DOCUMENTATION (Page 1 of 2)

Part 1 - Background Information AA 2

Evaluation Site: PLOWSHOP POND-EXIST. Date: 6-18-93

Site Location (Section, Range, and Township): AYER, MA.

Has the evaluator taken a training course in WET Version 2.0? YES

Agencies/Experts Contacted: SCS NOAA MA DF+W

Circle the assessment levels to be completed? SS-1 SS-2 E/O-1&2 E/O-3 HS

Is the wetland tidal or nontidal? If the wetland is nontidal, indicate the month(s) that represent wet, dry, and average conditions, or if only average annual condition will be used, give rationale. Also, indicate if the previous 12 months of precipitation has been above, below, or near normal.
NONTIDAL - WET CONDITIONS - HYDROLOGY - MARCH, VEGET.-MAY. DRY COND. - HYDROLOGY - AUG. VEGETATION - NOV. + AVG COND - HYDROL - JUNE, VEG - SEPT.

Is this evaluation an estimate of past conditions or a prediction of future conditions? (If answer is yes, explain nature and source of predictive data.)
NO

Will alternative ratings be used to evaluate any of the functions or values (if yes, explain)? NO

Part 2 - Identification and Delineation of Evaluation Areas

Sketch a map on the following page, or attach a suitable map (photocopy of topgraphic map) that shows the following information:

- -- Boundaries of the AA, IA, and IZ, and the location of service areas. (See Figure)
- -- Watershed boundaries of AA, and service areas.
- -- Extent of surface water in the AA during the wet and dry seasons.
- -- Open water (channels and pools) within and adjacent to the AA.
- -- Normal direction of channel or tidal flow
- -- Normal direction of wind-driven waves or current.
- -- Impact area(s).
- -- Scale of distance and north compass direction.

Explain the procedures used to identify or delineate the AA, IA, IZ, service areas, and the watersheds of these areas if they differed from the guidelines outlined in Section 2.7. N/A

-- Continued --

FORM A: SITE DOCUMENTATION (Page 2 of 2)

Part 2 (Cont.)

Estimate the extent of the following areas:

Assessment Area = ±25 acres
Impact Area = N/A acres (only if applicable).
Watershed of AA = — acres/ ±25 miles^2 (acres x 0.0016 = miles)
Wetlands in AA = ±25 acres
Wetlands in the watershed of closest service area = >500 acres
Wetlands and deepwater in the watershed of closest service area = >500 acres

How were locality and region defined for this evaluation?
locality – Town (AYER)
Region – State (Massachusetts)

Sketch of Evaluation Areas (or attach map):

See Figure 1

FORM B: EVALUATION ANSWER SHEET

Evaluation Site: PLOWSHOP POND AA Z

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 1

3.1.1 "Red Flags"

Comments/Assumptions

s1. Y N U - NOT LISTED BY MA. NATURAL HERITAGE
s2. Y N U
s3. Y N U
s4. Y N U
s5. Y N U
s6. Y N U

3.1.2 On-site Social Significance

Comments/Assumptions

s7. Y N U I
s8. Y N U I - SUPERFUND SITE ADJ. PLOWSHOP POND

3.1.3 Off-site Social Significance

Comments

s9. Y N U I
s10. Y N U - "Y" changed to "N"
s11. Y N U because: (1) Existing
s12. Y N U
s13. Y N U (2) wells >7%
s14. Y N U
s15. Y N U I - NAT. HER.
s16. Y N U I - GROVE POND WELL FIELD
s17. Y N U I
s18. Y N U I
s19. Y N U
s20. Y N U

Comments

s21. Y N U - BLACK DUCK, WOOD DUCK
s22. Y N U I
s23. Y N U
s24. Y N U
s25. Y N U - SUPERFUND SITE
s26. Y N U
s27. Y N U
s28. Y N U
s29. Y N U - MILITARY
s30. Y N U
s31. Y N U - NOT

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 2

Context Region (Circle one)

Standard Density Circle
Locality
Hydrologic Unit

Question #

Comments/Assumptions

1 Y N -
2 Y N -
3 Y N - ABOVE POND
4 Y N - FLOOD YEAR

FORM B (Cont.)

Evaluation Site: • PLOWSHOP POND – FT. DEVENS, AYER, MA AAZ

EFFECTIVENESS/OPPORTUNITY EVALUATION – LEVEL 1 (OFFICE)

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
1.1	Y N			
1.2	Y N – EROSIVITY FACTOR 125-5C			
1.3	Y N			
2.1.1	Y N			
2.1.2	Y N			
2.1.3	Y N			
2.2.1	Y N I			
2.2.2	Y N I – USGS TOPO + FIELD OBS.			
3.1	Y N			
3.2	Y N NWI MAP			
3.3	Y N			
4.1	Y N – [illegible] 100 mi			
4.2A	Y N			
4.2B	Y N			
4.2C	Y N			
4.2D	Y N			
5.1.1		Y N~3%		
5.1.2		Y N		
5.2		Y N – [illegible]		
6.1	Y N			
6.2	Y N			
7	Y N I			
8.1	Y N			
8.2	Y N			
8.3	Y N			
8.4	Y N			
9.1		Y N – constr. outlet – a & c true		
9.2		Y N I		
9.3		Y N I		
10A	Y N			
10B	Y N			
10C	Y N			
10D	Y N			
10E	Y N			
10F	Y N			

FORM B (Cont.)

Evaluation Site: PLOWSHOP POND AA-2

WETLAND CONDITION

Q.#	X̄	W	D
11	Y N	Y N	Y N
12A	Y N	Y N	Y N
12Aa	Y N	Y N	Y N
12Ab	Y N	Y N	Y N
12Ac	Y N	Y N	Y N
12Ad	Y N	Y N	Y N
12Ae	Y N	Y N	Y N
12B	Y N	Y N	Y N
12Ba	Y N	Y N	Y N
12Bb	Y N	Y N	Y N
12Bc	Y N	Y N	Y N
12Bd	Y N	Y N	Y N
12Be	Y N	Y N	Y N
12C	Y N	Y N	Y N
12Ca	Y N	Y N	Y N
12Cb	Y N	Y N	Y N
12Cc	Y N	Y N	Y N
12Cd	Y N	Y N	Y N
12D	Y N	Y N	Y N
12Da	Y N	Y N	Y N
12Db	Y N	Y N	Y N
12E	Y N	Y N	Y N
13A	Y N	Y N	Y N
13Aa	Y N	Y N	Y N
13Ab	Y N	Y N	Y N
13Ac	Y N	Y N	Y N
13Ad	Y N	Y N	Y N
13Ae	Y N	Y N	Y N
13B	Y N	Y N	Y N
13Ba	Y N	Y N	Y N
13Bb	Y N	Y N	Y N
13Bc	Y N	Y N	Y N
13Bd	Y N	Y N	Y N
13Be	Y N	Y N	Y N
13C	Y N	Y N	Y N
13Ca	Y N	Y N	Y N
13Cb	Y N	Y N	Y N
13Cc	Y N	Y N	Y N
13Cd	Y N	Y N	Y N
13D	Y N	Y N	Y N
13Da	Y N	Y N	Y N
13Db	Y N	Y N	Y N
13E	Y N	Y N	Y N

COMMENTS/ASSUMPTIONS

Dominant AA - AQUATIC BED, ROOTED VASCULAR

EDGE B - BROAD LEAVED DECIDUOUS

C - AQUATIC BED ROOTED VASCULAR

>10% - AQUATIC BED

>1 ACRE - SHRUB/SCRUB ALONG SHORELINE

FORM B (Cont.)

Evaluation Site: PLOWSHOP POND AAZ

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
14.1	Y N	Y N	Y N	– NONE OBSERVED
14.2	Y N	Y N	Y N	
15.1A	Y N I			
15.1B	Y N I			
15.1C	Y N I			
15.2	Y N I			NO CHANNEL FLOW
16A	Y N	Y N	Y N	PESTON AQUATIC BED
16B	Y N	Y N	Y N	
16C	Y N	Y N	Y N	
17	Y N			>70% AQUATIC BED OVER ~30 ACRE
18	Y N I			REGULAR W/B CONTS
19.1A	Y N I – 22 [illegible], LA[illegible], TOPO RELIEF			
19.1B	Y N I			
19.2	Y N I			
19.3	Y N I – VEG [illegible]			
20.1	Y N I			
20.2	Y N I			
21A	Y N [illegible]			
21B	Y N			
21C	Y N			
21D	Y N			
21E	Y N			
22.1.1	Y N			
22.1.2	Y N I			
22.2	Y N			
22.3	Y N I			
23	Y N DAM [illegible]			
24.1	Y N I – S[illegible] SOIL MAPS			
24.2	Y N I			
24.3	Y N I			
24.4	Y N I –			
24.5	Y N			
25.1	Y N – LANDFILL			
25.2A	Y N I			
25.2B	Y N I			
25.3	Y N – UNSTABLE SANDY SOILS			

Evaluation Site: ______________________

WETLAND CONDITION — COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
26.1	Y N — [illegible]		
26.2	Y N I — BENDWTR D[illegible]		
26.3	Y N I		
27.1	Y N [illegible]		
27.2	Y N I		
27.3	Y N I		

EFFECTIVENESS/OPPORTUNITY EVALUATION – LEVEL 2 (FIELD)

WETLAND CONDITION — COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D
28	Y N		
29.1	Y N — [illegible]		
29.2	Y N		
30.	Y N	Y N	Y N
31.1	Y N	Y N	Y N
31.2	Y N	Y N	Y N
31.3	Y N	Y N	Y N
31.4	Y N I	Y N I	Y N I [illegible]
31.5	Y N	Y N	Y N
31.6A	Y N	Y N	Y N
31.6B	Y N	Y N	Y N
31.6C	Y N	Y N	Y N
31.6D	Y N	Y N	Y N
31.6E	Y N	Y N	Y N
32A	Y N		
32B	Y N		
32C	Y N		
32D	Y N		
32E	Y N		
32F	Y N		
32G	Y N		
32H	Y N		
32I	Y N		
32J	Y N		
32K	Y N		

Evaluation Site: ______________________________

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
				WETLAND CONDITION
33A	Y N			
33B	Y N			
33C	Y N			
33D	Y N			
33E	Y N			
33F	Y N			
33G	Y N			
33H	Y N			
33I	Y N			
33J	Y N			
33K	Y N			
34.1	Y N			- DAM [illegible] - ON OLD USGS MAPS
34.2	Y N			
34.3.1	Y N			
34.3.2	Y N I			
35.1	Y N I			
35.2	Y N I			
36.1.1	Y N	Y N	Y N	
36.1.2	Y N	Y N	Y N	
36.2.1	Y N	Y N	Y N	
36.2.2	Y N	Y N	Y N	
36.2.3	Y N	Y N	Y N	
37	Y N			
38.1	Y N			- DAM [illegible] DOWNSTREAM - NONE [illegible]
38.2	Y N			
38.3	Y N			
38.4	Y N			
38.5	Y N			
38.6	Y N			
38.7	Y N			- FLOOD[illegible] 2 Mi [illegible]
38.8	Y N I			
39	Y N			TREES [illegible] MOST [illegible]
40.1	Y N I			
40.2	Y N I			
41.1		Y N I		
41.2		Y N I		

FORM B (Cont.)

Evaluation Site: ______________________________

Q.#	WETLAND CONDITION $\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
42.1.1	Y N I	Y N I	Y N I	
42.1.2	Y N I	Y N I	Y N I	
42.1.3	Y N I	Y N I	Y N I	
42.2.1	Y N I	Y N I	Y N I	– DOWNSTREAM REACH
42.2.2	Y N I	Y N I	Y N I	INACCESS TO FISH
42.2.3	Y N I	Y N I	Y N I	DUE TO DAM.
43A	Y N	Y N	Y N	
43B	Y N	Y N	Y N	
43C	Y N	Y N	Y N	
43D	Y N	Y N	Y N	
43E	Y N	Y N	Y N	– ECOL ENVIR REPORT
43F	Y N	Y N	Y N	PG 3-30 4/93
43G	Y N	Y N	Y N	
43H	Y N	Y N	Y N	
43I	Y N	Y N	Y N	
44A	Y N	Y N	Y N	
44B	Y N	Y N	Y N	
44C	Y N	Y N	Y N	
44D	Y N	Y N	Y N	FIELD OBSERV
44E	Y N	Y N	Y N	OF AQUATICS
44F	Y N	Y N	Y N	
44G	Y N	Y N	Y N	
44H	Y N	Y N	Y N	
44I	Y N	Y N	Y N	
45A	Y N			
45B	Y N			
45C	Y N			
45D	Y N			
45E	Y N			
45F	Y N			
45G	Y N			
46A	Y N	Y N	Y N	
46B	Y N	Y N	Y N	
46C	Y N	Y N	Y N	
47A	Y N			
47B	Y N	ESL 8/91		
47C	Y N			

FORM B (Cont.)

Evaluation Site: ________________________________

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
48A	Y N I	Y N I	Y N I	
48B	Y N I	Y N I	Y N I	
48C	Y N I	Y N I	Y N I	
48D	Y N I	Y N I	Y N I	
48E	Y N I	Y N I	Y N I	
48F	Y N I	Y N I	Y N I	
49.1.1	Y N I	Y N I	Y N I	- DAM [illegible]
49.1.2	Y N I	Y N I	Y N I	
49.2	Y N I	Y N I	Y N I	
49.3	Y N I	Y N I	Y N I	
50.	Y N	Y N	Y N	FISH DIRECTLY

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 3 (DETAILED DATA)

WETLAND CONDITION | COMMENTS/ASSUMPTIONS

Q.#	$\overline{X}$	W	D	COMMENTS/ASSUMPTIONS
51.1	Y N U			
51.2	Y N U			
52.1	Y N I U			
52.2	Y N I U			
53.1	Y N I U			
53.2	Y N I U			
54	Y N U	Y N U	Y N U	
55.1	Y N U			
55.2	Y N U			
55.3	Y N U			
55.4	Y N U			
56.1	Y N I U			
56.2	Y N I U			
57.1	Y N U			
57.2	Y N U			
58.	Y N U			

FORM B (Cont.)

Evaluation Site: ______________________

WETLAND CONDITION				COMMENTS/ASSUMPTIONS
Q.#	$\bar{X}$	W	D	
59.1	Y N I U			
59.2	Y N I U			
60	Y N U			
61	Y N I U			
62	Y N U			
63.1	Y N I U			
63.2	Y N I U			
64		Y N I U		

FORM C: SUPPLEMENTARY OBSERVATIONS

Evaluation Site: AA2 Plowshare Pond

Indicate the species, species groups, and activities that are actually observed, reliably reported, or known to occur at the AA on a regular basis.

FISH SPECIES GROUPS*	OBSERVED/REPORTED
1. Warmwater Group	Y or N
2. Coldwater Group	Y or N
3. Northern Lake Group	Y or N
4. Coldwater Riverine Group	Y or N

FISH SPECIES	OBSERVED/REPORTED
[illegible]	Y or N
[illegible]	Y or N
[illegible]	Y or N

WATERFOWL SPECIES GROUPS**

		OBSERVED/REPORTED NESTING	MIGRATING	WINTERING
1. Prairie Dabblers		Y or N	Y or N	Y or N
2. Black Duck		Y or N	Y or N	Y or N
3. Wood Duck		Y or N	117 Y or N	117 Y or N
4. Common and Red-Breasted Mergansers	119	Y or N	Y or N	Y or N
5. Hooded Merganser	122	Y or N	Y or N	Y or N
6. Canvasback, Redhead, Ruddy Duck	125	Y or N	Y or N	Y or N
7. Ring-necked Duck	128	Y or N	Y or N	Y or N
8. Greater and Lesser Scaup	131	Y or N	Y or N	Y or N
9. Common Goldeneye	134	Y or N	Y or N	Y or N
10. Bufflehead	137	Y or N	Y or N	Y or N
11. Whistling Ducks	140	Y or N	Y or N	Y or N
12. Inland Geese	143	Y or N	Y or N	Y or N
13. Tundra Swan	146	Y or N	Y or N	Y or N
14. Brant	149	Y or N	Y or N	Y or N

best judge very little data available on actual wintering use of this pond.

BIRD SPECIES	OBSERVED/REPORTED
Double-crested Cormorant (fish-eater)	Y or N
208 Belted Kingfisher	Y or N
249 Spotted Sandpiper	Y or N

Tree swallow 224

RECREATIONAL ACTIVITIES

Hiking	Sailing	Snowmobiling	Research
Birdwatching	Power Boating	Skiing	Educational Fieldtrips
Photography	Canoeing	Snowshoeing	Horseback Riding
Swimming	Kayaking	Ice Skating	

CONSUMPTIVE ACTIVITIES

catch + release only

Agriculture	Fur Harvesting	Commercial/Sport Fishing	Peat Harvesting
Hunting	Timber Harvest	Natural Food Gathering	Water Supply

Shotgun shells found in water

* Fish species groups are explained on page 138

** Waterfowl species groups are explained on page 1647

FORM D: EVALUATION SUMMARY SHEET

Evaluation Site: ____________________

Wetland Functions and Values

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge			*
Ground Water Discharge			*
Floodflow Alteration			
Sediment Stabilization			*
Sediment/Toxicant Retention			
Nutrient Removal/Transform.			
Production Export	*		*
Wildlife Diversity/Abundance**		*	*
Breeding	*		*
Migration	*		*
Wintering	*		*
Aquatic Diversity/Abundance			*
Uniqueness/Heritage		*	*
Recreation		*	*

Habitat Suitability Evaluation

Fish Species Groups:

____________ Group ___ ____________ Group ___ ____________ Group ___

Waterfowl Species Groups:

	Breeding	Migration	Wintering
Group ____________	___	___	___
Group ____________	___	___	___
Group ____________	___	___	___
Group ____________	___	___	___

Fish, Invertebrate, and Bird Species:

____________	___	____________	___	____________	___
____________	___	____________	___	____________	___
____________	___	____________	___	____________	___
____________	___	____________	___	____________	___

Levels of assessment completed: S-1 S-2 E/O-1 E/O-2 E/O-3 HS
Evaluation is for the: AA IA (Note: if the evaluation is for an IA, documentation of the AA evaluation must be presented with this evaluation).
Is there any evidence that suggests ratings contrary to the above (explain)?

____

Were alternative sources used for any of the ratings above (explain)? ________

____

The loss rate for ____________________ (identify locality/region) between 19__ and 19__ for ____________________ (identify wetland type) was ____________ (acres/year or % loss).

* WET does not evaluate this function or value in these terms.
** Wildlife Diversity/Abundance assesses only wetland-dependent birds. Other wildlife (e.g., game mammals) should be evaluated using other methods.

POST COLD

FORM A: SITE DOCUMENTATION (Page 1 of 2)

Part 1 - Background Information

Evaluation Site: COLD SPRING POND IA 1 POST-IMPACT - 3 yrs Date: 6/21/93

Site Location (Section, Range, and Township): AYER MA

Has the evaluator taken a training course in WET Version 2.0? YES

Agencies/Experts Contacted: SCS NOAA MA DF+W

Circle the assessment levels to be completed? SS-1 SS-2 E/O-1&2 E/O-3 HS

Is the wetland tidal or nontidal? If the wetland is nontidal, indicate the month(s) that represent wet, dry, and average conditions, or if only average annual condition will be used, give rationale. Also, indicate if the previous 12 months of precipitation has been above, below, or near normal.
NONTIDAL. Wet Cond - hydr - March veg - May Dry Cond - Hydro - Dec veg - Nov, Avg Cond - Hydro - June Veg. Sept

Is this evaluation an estimate of past conditions or a prediction of future conditions? (If answer is yes, explain nature and source of predictive data.)
NO

Will alternative ratings be used to evaluate any of the functions or values (if yes, explain)? NO

Part 2 - Identification and Delineation of Evaluation Areas

Sketch a map on the following page, or attach a suitable map (photocopy of topgraphic map) that shows the following information: SEE FIGURE 1

-- Boundaries of the AA, IA, and IZ, and the location of service areas.
-- Watershed boundaries of AA, and service areas.
-- Extent of surface water in the AA during the wet and dry seasons.
-- Open water (channels and pools) within and adjacent to the AA.
-- Normal direction of channel or tidal flow
-- Normal direction of wind-driven waves or current.
-- Impact area(s).
-- Scale of distance and north compass direction.

Explain the procedures used to identify or delineate the AA, IA, IZ, service areas, and the watersheds of these areas if they differed from the guidelines outlined in Section 2.7. N/A

-- Continued --

FORM A: SITE DOCUMENTATION (Page 2 of 2)

Part 2 (Cont.)

Estimate the extent of the following areas:

Assessment Area = N/A acres
Impact Area = ± 3 acres (only if applicable)
Watershed of AA = ± 50 acres/ 0.08 miles^2 (acres x 0.0016 = miles)
Wetlands in AA = ± 3 acres
Wetlands in the watershed of closest service area = >500 acres
Wetlands and deepwater in the watershed of closest service area = >500 acres

How were locality and region defined for this evaluation?
Locality - Town
Region - State

Sketch of Evaluation Areas (or attach map):

See Figure 1

FORM B: EVALUATION ANSWER SHEET

Evaluation Site: Cold Spring Pond   I A-1

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 1

3.1.1 "Red Flags"

Comments/Assumptions

s1.	Y	N	U	
s2.	Y	N	U	
s3.	Y	N	U	
s4.	Y	N	U	
s5.	Y	N	U	
s6.	Y	N	U	

3.1.2 On-site Social Significance

Comments/Assumptions

s7.	Y	N	U	I	
s8.	Y	N	U	I	Superfund site

3.1.3 Off-site Social Significance

					Comments
s9.	Y	N	U	I	"Y"
s10.	Y	N	U		S10
s11.	Y	N	U		Ch. due to
s12.	Y	N	U		<10% impv.
s13.	Y	N	U		open water >7%
s14.	Y	N	U		
s15.	Y	N	U	I	
s16.	Y	N	U	I	
s17.	Y	N	U	I	
s18.	Y	N	U	I	
s19.	Y	N	U		
s20.	Y	N	U		

					Comments
s21.	Y	N	U		
s22.	Y	N	U	I	
s23.	Y	N	U		
s24.	Y	N	U		
s25.	Y	N	U		– Superfund
s26.	Y	N	U		No SCDLP, no dug
s27.	Y	N	U		
s28.	Y	N	U		
s29.	Y	N	U		
s30.	Y	N	U		
s31.	Y	N	U		

SOCIAL SIGNIFICANCE EVALUATION - LEVEL 2

Context Region (Circle one)
- Standard Density Circle
- Locality
- Hydrologic Unit

Question #

Comments/Assumptions

1	Y	N	same as I-4
2	Y	N	
3	Y	N	
4	Y	N	

FORM B (Cont.)

Evaluation Site: Cold Springs IA-1

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 1 (OFFICE)

Q.#	$\bar{X}$	W	D	COMMENTS/ASSUMPTIONS
	WETLAND CONDITION			
1.1	Y N			
1.2	Y N			
1.3	Y N			
2.1.1	Y N			
2.1.2	Y N			
2.1.3	Y N			
2.2.1	Y N I			
2.2.2	Y N I			
3.1	Y N			
3.2	Y N			
3.3	Y N			
4.1	Y N [illegible]			
4.2A	Y N			
4.2B	Y N			
4.2C	Y N			
4.2D	Y N			
5.1.1		Y N		
5.1.2		Y N		
5.2		Y N		
6.1	Y N			
6.2	Y N			
7	Y N I			
8.1	Y N			
8.2	Y N			
8.3	Y N			
8.4	Y N			
9.1		Y N		
9.2		Y N I		
9.3		Y N I		
10A	Y N			
10B	Y N			
10C	Y N			
10D	Y N			
10E	Y N			
10F	Y N			

FORM B (Cont.)

Evaluation Site: Cold Sp T-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
11	Y N	Y N	Y N
12A	Y N	Y N	Y N
12Aa	Y N	Y N	Y N
12Ab	Y N	Y N	Y N
12Ac	Y N	Y N	Y N
12Ad	Y N	Y N	Y N
12Ae	Y N	Y N	Y N
12B	Y N	Y N	Y N
12Ba	Y N	Y N	Y N
12Bb	Y N	Y N	Y N
12Bc	Y N	Y N	Y N
12Bd	Y N	Y N	Y N
12Be	Y N	Y N	Y N
12C	Y N	Y N	Y N
12Ca	Y N	Y N	Y N
12Cb	Y N	Y N	Y N
12Cc	Y N	Y N	Y N
12Cd	Y N	Y N	Y N
12D	Y N	Y N	Y N
12Da	Y N	Y N	Y N
12Db	Y N	Y N	Y N
12E	Y N	Y N	Y N
13A	Y N	Y N	Y N
13Aa	Y N	Y N	Y N
13Ab	Y N	Y N	Y N
13Ac	Y N	Y N	Y N
13Ad	Y N	Y N	Y N
13Ae	Y N	Y N	Y N
13B	Y N	Y N	Y N
13Ba	Y N	Y N	Y N
13Bb	Y N	Y N	Y N
13Bc	Y N	Y N	Y N
13Bd	Y N	Y N	Y N
13Be	Y N	Y N	Y N
13C	Y N	Y N	Y N
13Ca	Y N	Y N	Y N
13Cb	Y N	Y N	Y N
13Cc	Y N	Y N	Y N
13Cd	Y N	Y N	Y N
13D	Y N	Y N	Y N
13Da	Y N	Y N	Y N
13Db	Y N	Y N	Y N
13E	Y N	Y N	Y N

FORM B (Cont.)

Evaluation Site: Cold Springs IA-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
14.1	Y N	Y N	Y N
14.2	Y N	Y N	Y N
15.1A	Y N I		
15.1B	Y N I		
15.1C	Y N I		
15.2	Y N I		
16A	Y N	Y N	Y N
16B	Y N	Y N	Y N
16C	Y N	Y N	Y N
17	Y N		
18	Y N I		
19.1A	Y N I		
19.1B	Y N I		
19.2	Y N I		
19.3	Y N I		
20.1	Y N I		
20.2	Y N I		
21A	Y N		
21B	Y N		
21C	Y N		
21D	Y N		
21E	Y N		
22.1.1	Y N		
22.1.2	Y N I		
22.2	Y N		
22.3	Y N I		
23	Y N		
24.1	Y N I		
24.2	Y N I		
24.3	Y N I		
24.4	Y N I		
24.5	Y N		
25.1	Y N		
25.2A	Y N I		
25.2B	Y N I		
25.3	Y N		

FORM B (Cont.)

Evaluation Site: Cold Spring I-1-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
26.1	Y N		
26.2	Y N I		
26.3	Y N I		
27.1	Y N		
27.2	Y N I		
27.3	Y N I		

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 2 (FIELD)

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
28	Y N		
29.1	Y N		
29.2	Y N		
30	Y N	Y N	Y N
31.1	Y N	Y N	Y N
31.2	Y N	Y N	Y N
31.3	Y N	Y N	Y N
31.4	Y N I	Y N I	Y N I
31.5	Y N	Y N	Y N
31.6A	Y N	Y N	Y N
31.6B	Y N	Y N	Y N
31.6C	Y N	Y N	Y N
31.6D	Y N	Y N	Y N
31.6E	Y N	Y N	Y N
32A	Y N		
32B	Y N		
32C	Y N		
32D	Y N		
32E	Y N		
32F	Y N		
32G	Y N		
32H	Y N		
32I	Y N		
32J	Y N		
32K	Y N		

FORM B (Cont.)

Evaluation Site: Cold Springs IA-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	$\bar{X}$	W	D
33A	Y N		
33B	Y N		
33C	Y N		
33D	Y N		
33E	Y N		
33F	Y N		
33G	Y N		
33H	Y N		
33I	Y N		
33J	Y N		
33K	Y N		
34.1	Y N		
34.2	Y N		
34.3.1	Y N		
34.3.2	Y N I		
35.1	Y N I		
35.2	Y N I		
36.1.1	Y N	Y N	Y N
36.1.2	Y N	Y N	Y N
36.2.1	Y N	Y N	Y N
36.2.2	Y N	Y N	Y N
36.2.3	Y N	Y N	Y N
37	Y N		
38.1	Y N		
38.2	Y N		
38.3	Y N		
38.4	Y N		
38.5	Y N		
38.6	Y N		
38.7	Y N		
38.8	Y N I		
39	Y N		
40.1	Y N I		
40.2	Y N I		
41.1		Y N I	
41.2		Y N I	

FORM B (Cont.)

Evaluation Site: Cold Springs I A-1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
42.1.1	Y N I	Y N I	Y N I
42.1.2	Y N I	Y N I	Y N I
42.1.3	Y N I	Y N I	Y N I
42.2.1	Y N I	Y N I	Y N I
42.2.2	Y N I	Y N I	Y N I
42.2.3	Y N I	Y N I	Y N I
43A	Y N	Y N	Y N
43B	Y N	Y N	Y N
43C	Y N	Y N	Y N
43D	Y N	Y N	Y N
43E	Y N	Y N	Y N
43F	Y N	Y N	Y N
43G	Y N	Y N	Y N
43H	Y N	Y N	Y N
43I	Y N	Y N	Y N
44A	Y N	Y N	Y N
44B	Y N	Y N	Y N
44C	Y N	Y N	Y N
44D	Y N	Y N	Y N
44E	Y N	Y N	Y N
44F	Y N	Y N	Y N
44G	Y N	Y N	Y N
44H	Y N	Y N	Y N
44I	Y N	Y N	Y N
45A	Y N		
45B	Y N		
45C	Y N		
45D	Y N		
45E	Y N		
45F	Y N		
45G	Y N		
46A	Y N	Y N	Y N
46B	Y N	Y N	Y N
46C	Y N	Y N	Y N
47A	Y N		
47B	Y N		
47C	Y N		

see mode

Evaluation Site: Cold Sp. AA 1

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
48A	Y N I	Y N I	Y N I
48B	Y N I	Y N I	Y N I
48C	Y N I	Y N I	Y N I
48D	Y N I	Y N I	Y N I
48E	Y N I	Y N I	Y N I
48F	Y N I	Y N I	Y N I
49.1.1	Y N I	Y N I	Y N I
49.1.2	Y N I	Y N I	Y N I
49.2	Y N I	Y N I	Y N I
49.3	Y N I	Y N I	Y N I
50.	Y N	Y N	Y N

EFFECTIVENESS/OPPORTUNITY EVALUATION - LEVEL 3 (DETAILED DATA)

WETLAND CONDITION

COMMENTS/ASSUMPTIONS

Q.#	X̄	W	D
51.1	Y N U		
51.2	Y N U		
52.1	Y N I U		
52.2	Y N I U		
53.1	Y N I U		
53.2	Y N I U		
54	Y N U	Y N U	Y N U
55.1	Y N U		
55.2	Y N U		
55.3	Y N U		
55.4	Y N U		
56.1	Y N I U		
56.2	Y N I U		
57.1	Y N U		
57.2	Y N U		
58.	Y N U		

FORM C: SUPPLEMENTARY OBSERVATIONS

Evaluation Site: ______________________________

Indicate the species, species groups, and activities that are actually observed, reliably reported, or known to occur at the AA on a regular basis.

FISH SPECIES GROUPS*	OBSERVED/REPORTED
1. Warmwater Group	Y or N
2. Coldwater Group	Y or N
3. Northern Lake Group	Y or N
4. Coldwater Riverine Group	Y or N

FISH SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

WATERFOWL SPECIES GROUPS**	OBSERVED/REPORTED		
	NESTING	MIGRATING	WINTERING
1. Prairie Dabblers	Y or N	Y or N	Y or N
2. Black Duck	Y or N	Y or N	Y or N
3. Wood Duck	Y or N	Y or N	Y or N
4. Common and Red-Breasted Mergansers	Y or N	Y or N	Y or N
5. Hooded Merganser	Y or N	Y or N	Y or N
6. Canvasback, Redhead, Ruddy Duck	Y or N	Y or N	Y or N
7. Ring-necked Duck	Y or N	Y or N	Y or N
8. Greater and Lesser Scaup	Y or N	Y or N	Y or N
9. Common Goldeneye	Y or N	Y or N	Y or N
10. Bufflehead	Y or N	Y or N	Y or N
11. Whistling Ducks	Y or N	Y or N	Y or N
12. Inland Geese	Y or N	Y or N	Y or N
13. Tundra Swan	Y or N	Y or N	Y or N
14. Brant	Y or N	Y or N	Y or N

BIRD SPECIES	OBSERVED/REPORTED
______________	Y or N
______________	Y or N
______________	Y or N

RECREATIONAL ACTIVITIES

Hiking	Sailing	Snowmobiling	Research
Birdwatching	Power Boating	Skiing	Educational Fieldtrips
Photography	Canoeing	Snowshoeing	Horseback Riding
Swimming	Kayaking	Ice Skating	

CONSUMPTIVE ACTIVITIES

Agriculture	Fur Harvesting	Commercial/Sport Fishing	Peat Harvesting
Hunting	Timber Harvest	Natural Food Gathering	Water Supply

* Fish species groups are explained on page 138
** Waterfowl species groups are explained on page 1647

FORM D: EVALUATION SUMMARY SHEET

Evaluation Site: ______________________________

Wetland Functions and Values

	Social Significance	Effectiveness	Opportunity
Ground Water Recharge	____	____	*
Ground Water Discharge	____	____	*
Floodflow Alteration	____	____	____
Sediment Stabilization	____	____	*
Sediment/Toxicant Retention	____	____	____
Nutrient Removal/Transform.	____	____	____
Production Export	*	____	*
Wildlife Diversity/Abundance**	____	*	*
Breeding	*	____	*
Migration	*	____	*
Wintering	*	____	*
Aquatic Diversity/Abundance	____	____	*
Uniqueness/Heritage	____	*	*
Recreation	____	*	*

Habitat Suitability Evaluation

Fish Species Groups:

__________ Group ___ __________ Group ___ __________ Group ___

Waterfowl Species Groups:

	Breeding	Migration	Wintering
Group __________	___	___	___
Group __________	___	___	___
Group __________	___	___	___
Group __________	___	___	___

Fish, Invertebrate, and Bird Species:

__________	___	__________	___	__________	___
__________	___	__________	___	__________	___
__________	___	__________	___	__________	___
__________	___	__________	___	__________	___

Levels of assessment completed: S-1 S-2 E/O-1 E/O-2 E/O-3 HS
Evaluation is for the: AA IA (Note: if the evaluation is for an IA, documentation of the AA evaluation must be presented with this evaluation).
Is there any evidence that suggests ratings contrary to the above (explain)?

____

Were alternative sources used for any of the ratings above (explain)? ________

____

The loss rate for ______________________ (identify locality/region) between 19__ and 19__ for ______________________ (identify wetland type) was __________ (acres/year or % loss).

* WET does not evaluate this function or value in these terms.
** Wildlife Diversity/Abundance assesses only wetland-dependent birds. Other wildlife (e.g., game mammals) should be evaluated using other methods.

****

Habitat Suitability Evaluation Results for "plowshop"

****

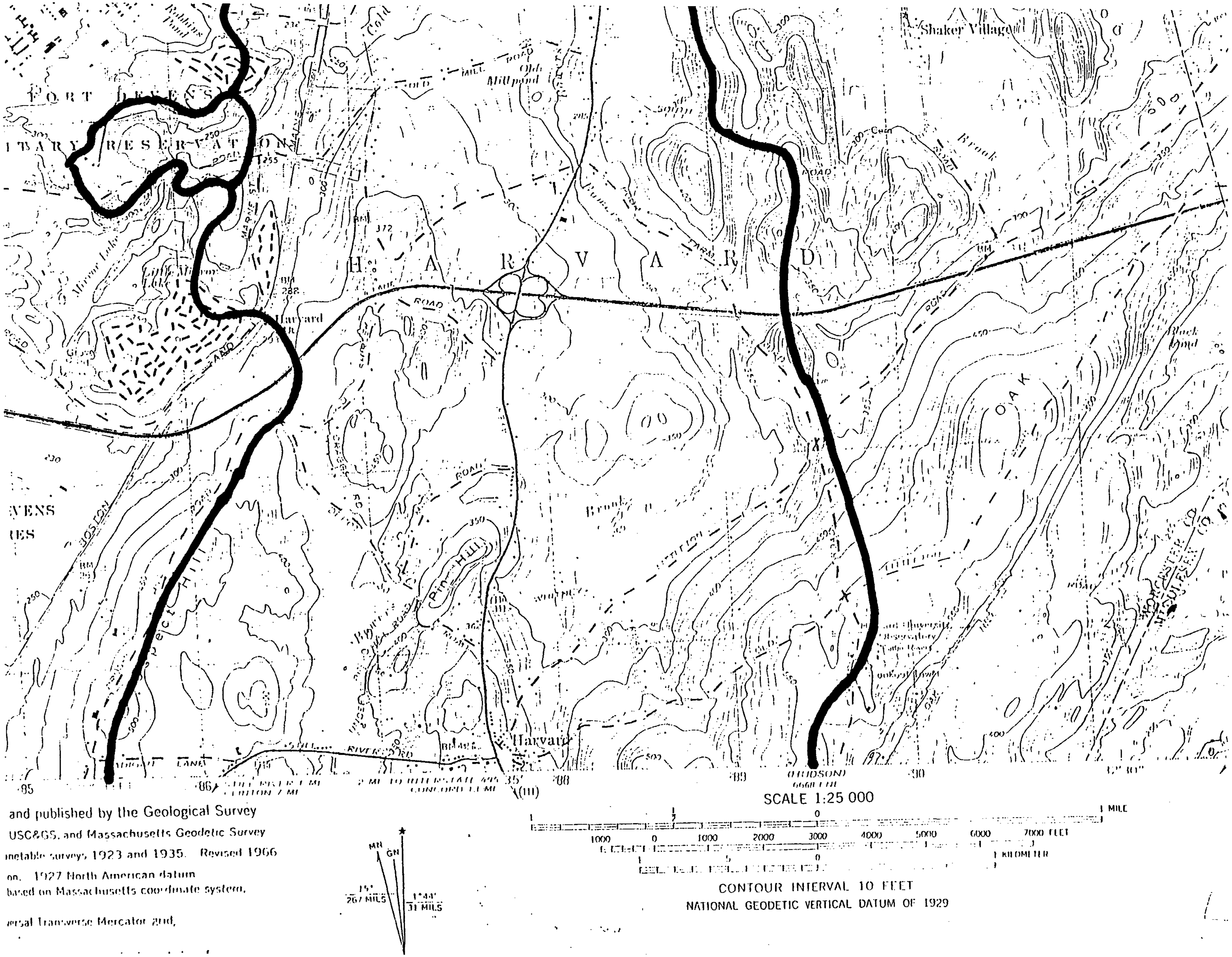
Species/Group	Rating	Observed
Warmwater Fish Group	H	y
Warmwater Fish Group	H	y
Warmwater Fish Group	H	y
Northern Lake Fish Group	H	y
Coldwater Fish Group	L	n
Coldwater Riverine Fish Group	L	n
Waterfowl Group 1 (Breeding)	L	y
Waterfowl Group 1 (Migration)	L	y
Waterfowl Group 1 (Wintering)	L	y
Waterfowl Group 2 (Breeding)	L	n
Waterfowl Group 2 (Migration)	L	y
Waterfowl Group 2 (Wintering)	L	n
Waterfowl Group 3 (Breeding)	M	n
Waterfowl Group 3 (Wintering)	L	n
Waterfowl Group 4 (Breeding)	L	n
Waterfowl Group 4 (Migration)	L	y
Waterfowl Group 4 (Wintering)	L	n
Waterfowl Group 5 (Breeding)	L	n
Waterfowl Group 5 (Migration)	H	y
Waterfowl Group 5 (Wintering)	L	n
Waterfowl Group 6 (Breeding)	L	n
Waterfowl Group 6 (Migration)	M	n
Waterfowl Group 6 (Wintering)	L	n
Waterfowl Group 7 (Breeding)	L	n
Waterfowl Group 7 (Migration)	L	y
Waterfowl Group 7 (Wintering)	L	n
Waterfowl Group 8 (Breeding)	L	n
Waterfowl Group 8 (Migration)	L	n
Waterfowl Group 8 (Wintering)	L	n
Waterfowl Group 9 (Breeding)	L	n
Waterfowl Group 9 (Migration)	M	n
Waterfowl Group 9 (Wintering)	L	n
Waterfowl Group 10 (Breeding)	L	n
Waterfowl Group 10 (Migration)	M	n
Waterfowl Group 10 (Wintering)	L	n
Waterfowl Group 11 (Breeding)	L	n
Waterfowl Group 11 (Migration)	L	n
Waterfowl Group 11 (Wintering)	L	n
Waterfowl Group 12 (Breeding)	L	y
Waterfowl Group 12 (Migration)	H	y
Waterfowl Group 12 (Wintering)	L	n
Waterfowl Group 13 (Breeding)	L	n
Waterfowl Group 13 (Migration)	L	n
Waterfowl Group 13 (Wintering)	L	n
Waterfowl Group 14 (Breeding)	L	n
Waterfowl Group 14 (Migration)	M	n
Waterfowl Group 14 (Wintering)	L	n
Belted Kingfisher	L	y
Spotted Sandpiper	L	y
Tree Swallow	M	y

****

Habitat Suitability Evaluation Results for "coldsprin"

****

Species/Group	Rating	Observed
Warmwater Fish Group	M	n
Coldwater Fish Group	L	n
Coldwater Riverine Fish Group	L	n
Northern Lake Fish Group	H	n
Yellow Perch	H	y
Bluegill	H	y
Smallmouth Bass	M	y
Redbreast Sunfish	H	y
Pumpkinseed	H	y
Waterfowl Group 1 (Breeding)	L	n
Waterfowl Group 1 (Migration)	H	y
Waterfowl Group 1 (Wintering)	L	n
Waterfowl Group 2 (Breeding)	L	n
Waterfowl Group 2 (Migration)	H	y
Waterfowl Group 2 (Wintering)	L	n
Waterfowl Group 3 (Breeding)	H	y
Waterfowl Group 3 (Migration)	H	y
Waterfowl Group 3 (Wintering)	L	n
Waterfowl Group 4 (Breeding)	L	n
Waterfowl Group 4 (Migration)	L	y
Waterfowl Group 4 (Wintering)	L	n
Waterfowl Group 5 (Breeding)	L	n
Waterfowl Group 5 (Migration)	H	y
Waterfowl Group 5 (Wintering)	L	n
Waterfowl Group 6 (Breeding)	L	n
Waterfowl Group 6 (Migration)	M	n
Waterfowl Group 6 (Wintering)	L	n
Waterfowl Group 7 (Breeding)	L	n
Waterfowl Group 7 (Migration)	L	y
Waterfowl Group 7 (Wintering)	L	n
Waterfowl Group 8 (Breeding)	L	n
Waterfowl Group 8 (Migration)	L	n
Waterfowl Group 8 (Wintering)	L	n
Waterfowl Group 9 (Breeding)	L	n
Waterfowl Group 9 (Migration)	M	n
Waterfowl Group 9 (Wintering)	L	n
Waterfowl Group 10 (Breeding)	L	n
Waterfowl Group 10 (Migration)	M	n
Waterfowl Group 11 (Breeding)	L	n
Waterfowl Group 11 (Migration)	L	n
Waterfowl Group 11 (Wintering)	L	n
Waterfowl Group 12 (Breeding)	L	n
Waterfowl Group 12 (Migration)	H	y
Waterfowl Group 12 (Wintering)	L	n
Waterfowl Group 13 (Breeding)	L	n
Waterfowl Group 13 (Migration)	L	n
Waterfowl Group 13 (Wintering)	L	n
Waterfowl Group 14 (Breeding)	L	n
Waterfowl Group 14 (Migration)	M	n
Waterfowl Group 14 (Wintering)	L	n
Green Heron	M	y



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